Variations in paediatric upper respiratory surgery rates

within and between two Nordic countries

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To my beloved husband

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Abstract

Upper respiratory operations, such as adenoidectomies, (adeno)tonsillectomies and tympanostomy tubes, are very common in children. Guidelines for treating upper respiratory infections exist, but the usefulness of these guidelines has been questioned and they have been poorly followed.

To prevent unnecessary procedures, recognizing the children who will benefit most from operative treatment is important. Treating upper respiratory infections surgically is also a major financial issue. Evaluation of surgery rates is necessary to rationalize the treatment. Variation in upper respiratory surgery rates in Finland or Norway has not been previously assessed.

In this study, paediatric upper respiratory surgery rates were assessed in and between Finland and Norway. The rates of adenoidectomy, tympanostomy tubes, myringotomy, tonsillectomy and adenotonsillectomy were collected from national databases – STAKES, NPR, Statistics Finland, Statistics Norway and various medical associations. Surgical rates were viewed in light of child density, geographical distribution, age and gender. In addition, the surgical rates were evaluated against the number, geographical distribution, age and gender of otorhinolaryngologists and general practitioners in Finland and Norway.

Differences in upper respiratory surgery rates (adenoidectomies, tympanostomy tubes and (adeno)tonsillectomies) were found in both Finland and Norway. In Finland, the largest difference was between the Western and Eastern catchment areas. In Norway, the greatest difference was between the Northern and Eastern catch-

ment areas. Throughout the study period, adenoidectomy rates remained higher in Finland than in Norway, but a striking decreasing trend was observed in Finnish rates. (Adeno)tonsillectomy rates remained, however, higher in Norway than in Finland throughout the study period, staying constant in Finland, while in Norway a weak increasing trend was observed. Finnish children are operated on at a younger age than Norwegian children.

Large national variation in upper respiratory surgery rates was present in both Finland and Norway, suggesting that some children may be undertreated and others overtreated. Variation in upper respiratory surgery rates between Finland and Norway was also observed, with a strong decreasing trend in adenoidectomy rates in Finland, seemingly resulting in converging upper respiratory surgery rates.

Key words: adenoidectomy, child, guideline, operative treatment, tonsillectomy, tympanostomy tube

Tiivistelmä

Lasten ylähengitystiekirurgia (kita-nielurisojen poisto ja tärykalvon putkitus) on länsimaissa erittäin yleistä. Leikkausten lukumäärät vaihtelevat niin kansallisesti kuin kansainvälisestikin, mutta selvää syytä näille eroille ei tiedetä. Hoitosuositusten merkitys käytäntöihin on kyseenalaistettu ja voi olla, ettei hoitosuosituksia noudateta. Leikkaukset saattavat aiheuttaa lapsipotilaille psykologisen vamman, ja lisäksi niihin sisältyy komplikaatioiden, jopa kuoleman, vaara. Jotta haittoja voidaan välttää, on tärkeää tunnistaa ne lapset, jotka hyötyvät leikkauksesta. Ongelma on paitsi lääketieteellinen, myös taloudellinen: ylähengitystiekirurgiasta aiheutuu merkittäviä kuluja. Leikkausmäärien arvioiminen on tärkeää, jotta leikkauskäytäntöjä voidaan järkeistää.

Tässä väitöskirjatyössä tutkittiin ylähengitystieleikkausten määriä Suomessa ja Norjassa sekä näiden kahden maan välillä. Aiempaa tutkimusta aiheesta ei kummassakaan maassa ole tehty. Kitarisanpoiston, välikorvan putkituksen, tärykalvopiston, nielurisanpoiston ja kita- ja nielurisanpoiston leikkausmäärät saatiin kansallisista tietokannoista. Lukuja verrattiin ko. maan lasten lukumäärään, maantieteelliseen sijoittumiseen sekä lasten ikään ja sukupuoleen. Lisäksi leikkausmääriä arvioitiin suhteessa korva-, nenä- ja kurkkulääkäreiden sekä yleislääkäreiden määrään, maantieteelliseen sijoittumiseen ja lääkäreiden ikään ja sukupuoleen.

Leikkausten määrissä havaittiin suurta vaihtelua niin Suomessa kuin Norjassa. Suomessa suurimmat erot leikkausmäärissä löydettiin läntisen ja itäisen miljoonapiirin välillä. Läntisessä piirissä tehtiin lähes kaksin kertaa enemmän leikkauksia kuin itäisessä

piirissä. Norjassa suurimmat erot olivat pohjoisen ja itäisen piirin välillä. Pohjoisessa piirissä tehtiin kaksinkertainen määrä leikkauksia itäiseen piirrin verrattuna. Suomessa tehtiin tutkimuksen koko aikavälillä enemmän kitarisanpoistoja kuin Norjassa, mutta ko. leikkausten määrä oli maassamme selvästi laskussa. Vuonna 2002 Suomessa tehtiin 2,5 kertaa enemmän kitarisanpoistoja kuin Norjassa. (Kita)nielurisanpoistoja tehtiin kuitenkin Suomessa vähemmän kuin Norjassa. Näiden leikkausten määrät pysyivät tutkimuksen aikavälillä Suomessa samalla tasolla, kun Norjassa leikkausmäärät hieman nousivat. Suomalaisia lapsia leikattiin keskimäärin paljon nuorempina kuin norjalaisia lapsia.

Tutkimuksessa ei löydetty selitystä ylähengitystieleikkausten määrän suurelle vaihtelulle Suomessa ja Norjassa tai maiden välillä. Kuitenkin Suomessa tehtyjen kitarisanpoistojen huomattavan vähenemisen myötä maiden ylähengitystieleikkausten määrät lähenivät toisiaan.

List of original publications

This thesis is based on the following publications, which are referred to in the text by Roman numerals I to V:

I. Haapkylä J, Karevold G, Kvaerner KJ, Pitkäranta A. Finnish adenoidectomy and tympanostomy rates in children; national variation. International Journal of Pediatric Otorhinolaryngology 2006; 70: 1569-1573.

II. Karevold G, Haapkylä J, Pitkäranta A, Nafstad P, Kvaerner KJ. Paediatric otitis media surgery in Norway. Acta Oto-Laryngologica 2007; 127: 29-33.

III. Karevold G, Haapkylä J, Pitkäranta A, Kvaerner KJ. Otitis media surgery: large variability between Finland and Norway. International Journal of Pediatric Otorhinolaryngology 2007; 71: 1035-1039.

IV. Haapkylä J, Karevold G, Kvaerner KJ, Pitkäranta A. Trends in otitis media surgery: a decrease in adenoidectomy. International journal of Pediatric Otorhinolaryngology 2008; 72: 1207-1213.

V. Haapkylä J, Karevold G, Kvaerner KJ, Pitkäranta A. Paediatric adenotonsillectomy: a Nordic comparison. Submitted.

Abbreviations

AOM: acute otitis media

DCA10: myringotomy

DCA20: tympanostomy tubes

EMB10: tonsillectomy

EMB20: adenotonsillectomy

EMB30: adenoidectomy

GABHS: group A beta haemolytic streptococcus

GP: general practitioner

NPR: Norwegian Patient Registry

OM: otitis media

OME: otitis media with effusion

ORL: otorhinolaryngologist

RAOM: recurrent acute otitis media

STAKES: Finnish National Research and Development Centre for Welfare and Health

1. Introduction

Upper respiratory infections, such as otitis media (OM) and tonsillitis, are very common in children – OM is in fact the most common childhood disease. Adequate treatment of OM and tonsillitis has raised much discussion over the past decades (1-4). When infections become recurrent or antibiotic treatment is insufficient, surgical interventions, including tympanostomy tubes and (adeno)tonsillectomies, may be needed. Insertion of tympanostomy tubes for OM is one of the most frequently performed operations in children (5). It has been estimated that over 30% of children have at least one upper respiratory surgery performed before the age of 21 years (6). Studies on adenotonsillectomies show large variation in clinical outcomes (7), and surgery rates indicate marked differences in clinical practices worldwide (3,8-12).

Clinical practice guidelines concerning tympanostomy tubes and/or (adeno)tonsillectomies have been published in many countries (13-17); however, adherence to recommendations is low (18,19). In a recent study, only 30% of tympanostomies met specific criteria and only 7.5% were concordant with guidelines (18,19). These results suggest evidence of overuse of tympanostomy tubes, and many children receive tympanostomy tubes with minimal or only mild OM. Already decades ago, the discrepancy in performing (adeno)tonsillectomies between clinical practice and guidelines was marked (20). A survey from the Netherlands indicated that other indications, such as poor appetite and listlessness, played an equally important role as the generally accepted indications in the decision to perform tonsil surgery (21). This finding suggests in-

consistencies with the current practice guidelines also in the use of (adeno)tonsillectomies.

Clinical epidemiology of tympanostomy tubes and/or (adeno)tonsillectomies in Finland and Norway has not been well characterized. Other surgery rates, such as those for mastectomy, hip replacement and uterus operations (22), including hysterectomy (23) and orthopaedic procedures (24) in Finland and parathyroid surgery (25) in Norway, have shown considerable national variation without a good explanation.

To assess current practices in treating upper respiratory infections surgically, it is important to determine what has been done previously. The evaluation of paediatric upper respiratory surgery rates is the first step in rationalizing the treatment of upper respiratory infections in children.

2. Review of the literature

2.1 Otitis media and tonsillar diseases in children: risk factors and treatment guidelines

2.1.1 Otitis media

OM is defined as inflammation of the middle ear and has a wide range of clinical manifestations. The term otitis media with effusion (OME) refers to effusion in the middle ear without any acute symptoms. Chronic OME refers to persistence of middle ear effusion usually for more than three months. Acute otitis media (AOM) refers to effusion in the middle ear with acute symptoms such as pain, fever or possibly otorrhoea. Children especially can also present with vomiting and diarrhoea. AOM is considered recurrent (RAOM) if the child has three AOM episodes in six months or four episodes in a year (26). Originally, a child was defined as 'otitis prone' when she/he had more than six episodes of OM before the age of six years; this condition was first described by Howie in 1975 (27). It is difficult, if not impossible, to predict which child will be otitis prone in the future (28,29). An estimated 15% of the child population suffers from RAOM (29).

OM (30,31) and AOM (32) are very common during childhood and the incidence is high, especially in young children. Almost all children under two years of age (91%) have had at least one episode of middle ear effusion (33), and two-thirds have had at least one episode of AOM (34). Accurate diagnostics requires pneumatic otoscopy, preferably supplemented with tympanometry (35). Recur-

rent middle ear infections have become more common, while the clinical picture of AOM has become less severe (36). In Finland, the number of AOM diagnoses has increased from the 1970s to the 1990s (37), without any good explanation. A survey from Australia, in turn, indicated that the percentage of children with OM has remained unchanged during the 1990s (38).

A well known environmental risk factor for AOM or RAOM is contact with other children either in day care or at home (39-45). Other risk factors include exposure to environmental tobacco smoke (39,41,45-47), use of a pacifier (45) and male sex (39). Almost all of these are also risk factors for upper respiratory infections (40), which actually can be considered one of the most important environmental risk factors for AOM (41,43). Similar risk factors have been associated with OME (48). Breast feeding for more than six months, in turn, is associated with a reduced risk of AOM (39).

The rationale in the treatment of AOM is to reduce pain and fever and prevent complications, while simultaneously alleviating parental anxiety and considering costs (49). On average, 80% of children with AOM will improve without any treatment within a few days, but at the moment we are unable to identify the remaining 20% who need treatment (50). The objective in the treatment of chronic OME is to improve hearing.

AOM may lead to several complications and sequelae even when treated with antibiotics (51). Failure to recognize AOM requiring treatment may lead to an increasing number of acute mastoiditis cases (52,53). OME and recurrent AOM have been suspected of hindering speech and language development (54-56), although evidence of normal development has also emerged (57).

Finnish national guidelines suggest amoxicillin for five days as the first-line antibiotic for treating AOM. If a child has three episodes of AOM in six months or four episodes in one year, an otorhinolaryngologist (ORL) should be consulted (16,17). In addition, if middle ear effusion lasts longer than two months, an ORL should be consulted. While the first Finnish consensus conference on OM treatment in 1987 recommended adenoidectomy for preventing recurrent AOM (58), the revised national guidelines, published in 1999, no longer advised adenoidectomy as the first choice of surgical treatment in otitis-prone children (16). The most recent update is from 2004 (35). The child will receive tympanostomy tubes as a first-line treatment, depending on the severity of the illness, followed by adenoidectomy and/or tonsillectomy, if especially indicated.

In Norway, national guidelines for general practitioners (GP) and ORLs have existed since 1997 and do not include strict recommendations about the surgical treatment of OM, thus leaving this to the discretion of the physician. Following an observation period of 3-6 months, adenoidectomy with myringotomy or insertion of tympanostomy tubes is performed in children with chronic OME. No national guidelines have been developed for RAOM, although it is recommended that affected children should be referred to an ORL for follow-up (59).

2.1.2 Tonsillar diseases

Tonsillar tissue is mainly located in four areas in the pharynx. Together with the adenoid and the lingual tonsil, the palatine tonsils

form a structure called Waldeyer's ring (Figure 1). A child is born with these structures, which suggests that they serve an important function. However, the definitive function of Waldeyer's ring as part of the immune system is incompletely understood. Waldeyer's ring grows throughout childhood until pre-puberty, thereafter decreasing gradually (60).

Clinically, tonsillitis is defined as infection of the palatine tonsillar tissue; other tonsillar tissue may also be involved. Acute tonsillitis may be associated with fever, sore throat, headache and, especially in children, stomach ache, nausea and vomiting (61). Tonsillitis may be caused by a wide variety of microbial agents, viruses and bacteria (62). The most important pathogen related to tonsillectomy is group A beta haemolytic streptococcus (GABHS) because of potential complications. Tonsillitis is considered recurrent if a patient has four or more GABHS-positive episodes in a year (61).

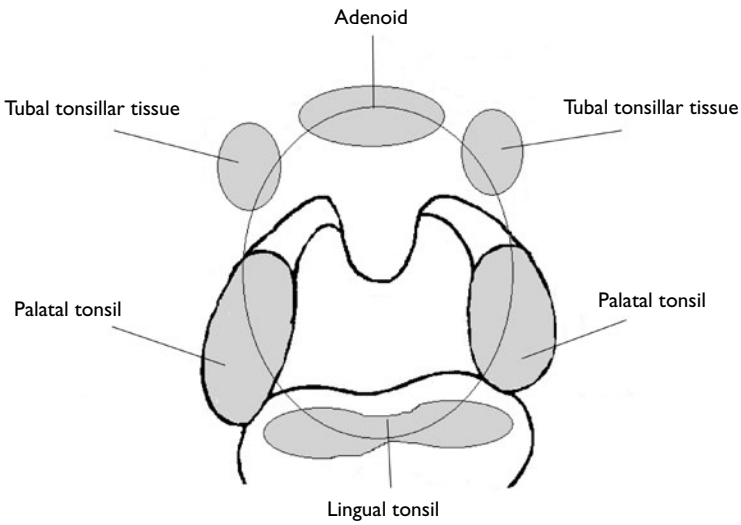

Figure 1. Waldeyer's ring.

(Adeno)tonsillar hypertrophy is the enlargement of palatine tonsils and/or adenoid tissue. (Adeno)tonsillar hypertrophy may cause dysphagia, swallowing difficulties and hyponasal speech. It is also associated with mouth breathing and snoring and may cause obstructive sleep apnoea and sleep disruptions.

There are few published risk factors associated with tonsillitis. One study suggested home dampness and atopy to be associated with an elevated risk for tonsillitis (63). Long usage of the same toothbrush has been suggested as a factor in recurrent GABHS tonsillitis (64). Children with recurrent tonsillitis with moderate symptoms have not, however, been shown to have more GABHS in their throat cultures than healthy children (65). Risk factors for (adeno)tonsillar hypertrophy have not been identified.

The rationale for treating acute tonsillitis in Finland is to ease symptoms, prevent complications by eradicating GABHS from the pharynx and prevent epidemics (61). The diagnostics must be accurate and include an antigen detection and/or culture from the infected tonsils. If GABHS is found, antibiotic treatment is indicated (61).

The purpose of antibiotic treatment is to prevent complications, such as peritonsillar abscesses and deep para- and retropharyngeal abscesses. Even mediastinitis has been described as a complication of acute tonsillitis (66). Immunomediated complications include scarlet fever, acute glomerolunephritis and rheumatic fever (61,67), all of which used to be common, but have now virtually disappeared.

National guidelines for tonsillitis have existed in Finland since 1999 (61). The Finnish guidelines suggest penicillin for ten days as

the first treatment for GABHS-positive tonsillitis. Tonsillectomy should be considered when a patient has more than four GABHS-positive infections in a year, when a peritonsillar abscess fails to heal with drainage and medication or when a patient suffers from recurrent peritonsillar abscesses. Children's peritonsillar abscesses are always treated with tonsillectomy (61). Adenotonsillectomy is also used to treat sleep apnoea and snoring in children when hypertrophy is present. Children with obstructive (adeno)tonsillar tissue may benefit from (adeno)tonsillectomy (68-70).

In Norway, national guidelines have existed since 1997. The guideline for GPs suggests penicillin for 10 days to treat acute GABHS-positive tonsillitis. The guideline for ORLs suggests tonsillectomy if acute tonsillitis occurs 3-4 times per year for two consecutive years or if the tonsils are abscessed. Tonsillectomy is indicated if the patient has chronic tonsillitis with foetor ex ore-occurring mainly in adults- and hypertrophied tonsils with symptoms of sleep apnoea or problems in swallowing. (15).

2.2. Paediatric upper respiratory surgery

2.2.1 Tympanostomy tubes

Already Hippocrates (ca. 460 BC – 370 BC) and Aristotle (ca. 380 BC – 320 BC) recognized OME and suggested incision of the eardrum as its cure. The first formal myringotomy was performed in 1649, but it was not until 1845 that gold tubes were used to keep the myringotomy perforation open. (71–73). The first modern ventilation tube was introduced in 1954 in the United States (74).

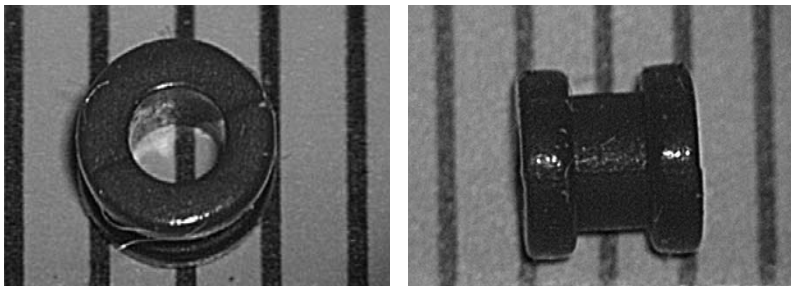

Figure 2. The Donaldson tube (distance between two lines is 1 mm).

Tympanostomy tube is a small synthetic prosthesis (Figure 2) inserted in children mainly under general anaesthesia through the tympanic membrane to equalize the pressure between the middle and outer ear. After incision of the tympanic membrane with a knife, tympanostomy tubes are put in place with small pliers. Indications for tympanostomy tubes include RAOM and chronic OME (Table 1).

Tympanostomy tubes are considered beneficial in removing persistent middle ear effusion (5). Results on the benefits of tympanostomy tubes are controversial. Tympanostomy tubes decrease the risk for AOM (75,76) and produce short-term improvements in the quality of life from 34 days to six months after the operation (77,78). Tympanostomy tubes have also been shown to alleviate parental concern about their children's ear problems (78).

Table 1. Indications for tympanostomy tubes in Finland and Norway.

Recurrent acute otitis media (episodes ≥3 in 6 months or ≥4 in 12 months)
Chronic otitis media with effusion (effusion > 2–3 months)

ref (14–17)

However, tympanostomy tubes did not improve the quality of life of children with persistent OME who were aged less than two years (79). Tympanostomy tubes early in life had no significant impact on children's development or phonological and auditory processing skills compared with insertion later in life (80,81).

Complications associated with tympanostomy tubes comprise tympanic membrane scarring, chronic low-grade hearing loss, otorrhoea, cholesteatoma, persistent perforation and the risks of general anaesthesia (76,82-86), with such acute complications as intraoperative haemorrhage, which may obstruct the tube lumen. Tympanosclerosis, retraction of the tympanic membrane and atrophy were more common in tympanic membranes that had received tubes (76). A 25-year follow-up showed more myringosclerosis and atrophy in ears treated with tympanostomy tubes, but no association with atelectasis, perforation and cholesteatoma was found (87). Approximately every sixth child undergoing the tympanostomy tube operation is expected to have at least one minor complication of the procedure, the most common being otorrhoea (88). Even though tympanostomy tubes are not without risks for adverse effects (89), they are considered safe enough to be justified in the treatment of OM (82,83).

Children who have their first set of tympanostomy tubes before one year of age are more likely to have two or more tympanostomy tubes (90), and of all children, one in five will require a second set of tympanostomy tubes (86). The peak age for tympanostomy tubes is in the second year of life (90).

In Finland, operative treatment for a child with recurrent or prolonged OM is considered if the child has three or more AOM episodes in six months or four or more AOM episodes in a year or

middle ear effusion that lasts more than two months (91). Guidelines from other countries also exist. The American Academy of Pediatrics recommends tympanostomy tubes if a child has had bilateral effusion for a total of three months together with bilateral hearing deficiency (14), and the guideline for treating OME suggests tympanostomy tube insertion as the first surgical procedure (92). After the insertion of tympanostomy tubes, the child should be followed up, preferably by an ORL, 1-3 months after the operation and thereafter every six months until the tubes have fallen off. This usually happens 6-18 months after tympanostomy with Donaldson tubes (88). Even though guidelines for treating OM exist, tympanostomy tubes are overused in a considerable proportion of children. Children have been shown to receive tympanostomy tubes after less than two episodes of AOM or less than 42 consecutive days of middle ear effusion (18,19).

2.2.2 Adenoidectomy

The adenoid is a lymphoepithelial organ situated in the nasopharynx (93). Adenoid tissue is part of the lymphatic tissue lining the upper respiratory tract and is important in the normal function of the tract (93) (Figure 1). The adenoid tissue was not discovered and named until the latter part of the 19th century because of its location in the upper pharynx (71). In 1858 the Danish doctor, Willhelm Meyer, described removal of the adenoids, and in 1867 he constructed a ring-shaped knife to remove this tissue (94,95).

The objective for adenoidectomy is to remove chronically infected or hypertrophied tissue. Adenoidectomy is performed with

Table 2. Indications for (adeno)tonsillectomy.

Snoring	Recurrent/chronic rhinitis/rhinosinusitis?
Obstructive sleep apnoea	Recurrent acute otitis media?
Otitis media with effusion in children with other medical problems	Abnormal dentofacial growth?
Otitis media with effusion relapses after tympanostomy tubes	Mouth breathing?
Nasal obstruction	
Associated speech problems	
Recurrent Group A beta haemolytic streptococcus tonsillitis	
Suspicion of malignant disease	

ref (97,98,116)

a ring knife, and the procedure is controlled with a mirror. Haemostasis is ensured by pressurizing the operation area with a wad, supplemented with electrocautery when necessary. Adenoidectomy requires general anaesthesia in children. Major indications for adenoidectomy have been OM, sinusitis or obstructive symptoms (96) and adenoid hypertrophy and infection of the adenoids (97,98) (Table 2). As OM is an indication for adenoidectomy, predisposing factors for OM affect the occurrence of adenoidectomy; day care attendance has been shown to increase the rate of adenoidectomies by 67% (99), and boys have been operated on more frequently (38,96,100).

Adenoidectomy is beneficial in restoring normal breathing through the nose if the hypertrophied adenoid obstructs the nasopharynx. Adenoidectomy is also suggested to reduce the risk for additional hospitalization and operations related to OM (101) and is thought to provide an additional benefit in treating ear diseases (97,98). Adenoidectomies are reported to reduce the number of

tympanostomy tube reinsertions in children older than four years who attend day care centres (102). Adenoidectomy may prevent AOM (75) and the operation is suggested to be more effective in resolving OME in older children (103,104).

Complications resulting from an adenoidectomy include intra- and postoperative haemorrhage, burns and soft-tissue injury (face, mouth and throat), fever, otalgia, sore throat, dehydration, infection, Eustachian tube injury and complications associated with general anaesthesia (105). Complications are, fortunately, relatively uncommon.

Adenoidectomy during the insertion of tympanostomy tubes in children under two years of age does not seem to offer a major advantage over insertion of tympanostomy tubes alone in preventing OM (106). Adenoidectomy does not reduce the incidence of AOM in conjunction with tympanostomy tubes in children younger than four years (107), nor does it reduce the number of AOM episodes, visits to a physician, antibiotic prescriptions or days with symptoms of upper respiratory infections in children aged less than two years (49).

Specific guidelines for the use of adenoidectomy do not exist. Finnish guidelines for AOM do not recommend adenoidectomy as a first-line treatment (35). An American guideline for treating OME does not advise adenoidectomy unless a distinct indication, such as nasal obstruction, exists (92). Adenoidectomy should not be routinely considered as a first surgical intervention in children with RAOM (108). Adenoidectomy is not recommended in treating uncomplicated middle ear effusion in children aged less than four years (14). A retrospective study from Australia, however, suggests that adenoidectomy or adenotonsillectomy is associated with a reduced risk for further upper respiratory surgery and recommends it as a

first-line management option for treating OME (109). Moreover, in the treatment of obstructive sleep apnoea and associated conditions (e.g. snoring), adenoidectomy has proven beneficial (68-70).

In conclusion, at present, adenoidectomy is not a first-line treatment in middle ear disease in children with no evident nasopharyngeal obstruction or chronic rhinosinusitis.

2.2.3 Tonsillectomy

Already two thousand years ago, Celsus wrote in his 'De Medicina' about 'indurated tonsils' and their treatment – tonsils could be eunucleated by fingers or excised with a mechanical device (95,110). After 1700, surgeons began to ligate the tonsils and excise the projecting portion. Soon thereafter, specific instruments, including a variety of guillotines, were introduced. Until the 20th century, however, tonsillectomy was uncommon (110). When electricity and adequate anaesthesia became available, tonsillectomy started to rise in popularity (95). The period 1902-1903 marked the beginning of a rapid rise (3), and after 1910 tonsillectomy became the most common surgical procedure in the United States (94,110). During World War I, the number of tonsillectomies decreased for some time, after which the rise accelerated sharply (3), reaching a peak in the 1940s. In the early 1960s, 5% of children aged less than 14 years had had their tonsils removed in the United Kingdom (111).

In tonsillectomy, the infected or hypertrophied palatine tonsillar tissue (Figure 1) is removed. In adenotonsillectomy, both adenoid and palatine tonsillar tissues are removed. The technique of extra-capsular tonsillectomy, removal of all tonsillar tissue along its

capsule, has not changed significantly over the past decades. Devices used for tonsillectomy have includes snares, forceps, guillotines, scalpels, lasers, ultrasonic scalpels, powered microdebriders and bipolar scissors. The operation requires general anaesthesia in children.

The frequency of tonsillectomies by age is multimodal; the frequency increases in preschool-aged children, declines thereafter, and increases again in teenagers (3,96,112). Tonsillar hyperplasia is the most frequent diagnosis among children aged less than ten years and peritonsillar abscess among teenagers (96). Predisposing factors have been suggested to include male sex (3,11,100,113,114). Children who have a physician in the family were shown to have less tonsillectomies than children with no physician in proximity (115).

Indications for (adeno)tonsillectomy include recurrent tonsillitis and obstructive sleep apnoea (Table 2). American and Australian publications list (adeno)tonsillar hyperplasia with obstructive sleep apnoea, failure to thrive or abnormal dentofacial growth; suspicion of malignant disease; and haemorrhagic tonsillitis as absolute indications. Relative indications include hyperplasia with upper airway obstruction and recurrent (minimum of seven attacks in two years) or chronic pharyngotonsillitis. (97,98,116). A survey in the Netherlands showed, however, that in addition to generally accepted indications, such as recurrent tonsillitis and obstructive sleep apnoea, other indications (OM, listlessness, poor appetite) had an equally important role in the decision to offer surgery (21).

Tonsillectomy is effective in reducing sore throat episodes in adults with recurrent GABHS-positive tonsillitis (117). In children,

tonsillectomy has been shown to be beneficial in treating periodic fever (118). One of tonsillectomy's benefits is that it seems to ease parental anxiety – 95% of parents of patients who responded to a questionnaire were 'glad' that the surgery had been performed (119). Children with obstructive sleep apnoea are thought to benefit from tonsillectomy, with improvement in both quality of life and metabolic alterations (68-70). Removal of the tonsils and adenoids is considered safe, with no known long-term immunological side-effects (96,120) and no increase in adulthood asthma or atopic disease (121).

Discussion about tonsillectomy's benefits has continued for decades (3,122-125), and results on its benefits are controversial. In children, adenotonsillectomy was suggested to decrease the carriage rate of GABHS, but did not decrease the number of throat infection episodes (126). A meta-analysis showed that adenotonsillectomy produces a modest reduction in sore throat episodes, in school absence associated with sore throat and in upper respiratory infections compared with no surgery (7), but these benefits do not exceed the risks of the operation. Adenotonsillectomy has not been beneficial in treating OM (127). Adenotonsillectomy resulted in an overall increase in costs of 46% (250 €) compared with watchful waiting in children with mild or moderate symptoms of throat infection or adenotonsillar hypertrophy and did not produce a relevant clinical benefit (128).

The most common serious complication arising from a tonsillectomy is primary or secondary haemorrhage. Primary haemorrhage occurs in less than 4% of operations (129), while secondary haemorrhage occurs in 2.5–4.1% (130). In an adult population, some

degree of secondary haemorrhage was reported in 32.8% of cases (131). Other complications include perioral burns (132), otalgia, dehydration, infections and even death (105). Postoperative throat pain is considerable and may last for two weeks (mean duration 10.7 days) (131), and frequent use of anti-inflammatory medication is not without risks either.

In conclusion, (adeno)tonsillectomy as a treatment for recurrent throat infections in children has been shown to have only modest benefits, and these benefits do not exceed the risks, morbidity and costs related to the operation (4).

Guidelines for the use of tonsillectomy have existed for some time, but the indications in the guidelines are apparently not being met (20,111). Current practice guidelines in Finland suggest tonsillectomy when a patient has recurrent tonsillitis (four or more GABHS-positive episodes in a year) despite medical treatment, when a peritonsillar abscess does not heal despite drainage and antimicrobial treatment or when it renews or a child has peritonsillar abscess (61). Operative treatment is suggested also if the patient has chronic tonsillitis or if a child has periodic fever or obstructive apnoea due to tonsillar hypertrophy (133). Norwegian national guidelines suggest tonsillectomy if acute tonsillitis occurs 3-4 times per year for two consecutive years or if the tonsils are abscessed. Tonsillectomy is indicated if the patient has chronic tonsillitis with foetor ex ore, hypertrophied tonsils with symptoms of sleep apnoea or problems in swallowing (15). Tonsillectomy is not recommended as a treatment for OME (14,92). Specific guidelines for adenotonsillectomy in Finland or Norway have not been published.

2.3 Variation in upper respiratory surgery rates

Variation in upper respiratory surgery (tympanostomy tubes, adenoidectomies, tonsillectomies and adenotonsillectomies) has been marked and studied for a long time. No good explanation for the variation has been uncovered.

Table 3. Studies on tympanostomy tubes.

Study	Year	Country	Age (years)	Rate (per 1000 children)	Findings
Derkay (100)	1977 1987	USA	0-14	4.3* 1.2*	Decreasing trend
Black (134)	1975 1990	England	0-9	48% ** 94% **	National variation Increasing trend
Bisset et al. (11)	1990	Scotland	0-15	2.4-9.2	National variation
Bisset (135)	1990 1994	Scotland	0-15	1.6-6.3 1.8-5.7	National variation
Mason et al. (136)	1989 1996	Scotland	0-14	1.8 0.8	National variation Decreasing trend
Owings et al. (145)	1996	USA	0-14	8.9	Tympanostomy tubes is the most frequently performed operation
Coyte et a.l (101)	1996-1999	Canada	0-14	8.4	National variation
Desai et al. (90)	1997-2000	Canada	0-0.9 1-1.9 2-2.9 0-15	12.8 54.2 25.6 11.1	Peak age for tympanostomy tubes in the second year of life
Schilder et al. (9)	1990s	Netherlands USA Scotland England and Wales	0-14	20 9 5 2	International variation

* myringotomy ± insertion of tympanostomy tubes
**proportion of otitis media with effusion operations in which tympanostomy tubes were inserted

Both international and national variation in tympanostomy tube rates (9,11,101,134-136), adenoidectomy rates (9,135), tonsillectomy rates (10-12) and adenotonsillectomy rates (8,134,135,137-144) has been shown.

All upper respiratory operations have been in and out of favour many times over the past decades. Increasing and decreasing trends for typanostomy tubes (90,100,134,136,145), adenoidectomies (38,100,146-149), tonsillectomies (3,38,100,112,113,146-148,150) and adenotonsillectomies (100,113,145,146,148,149,151) have been described.

Studies on variation in tympanostomy tubes are presented in Table 3, in adenoidectomies in Table 4, in tonsillectomies in Table 5 and in adenotonsillectomies in Table 6.

2.4 Finland and Norway – two comparable Nordic countries

Finland and Norway resemble each other in several ways (Table 7). Both countries are geographically located in the sub-arctic area, with similar population sizes and densities. The population pyramids for the paediatric population in both countries are presented in Figure 3. The organizational structure and funding of health care are similar (152,153), and even the distribution of GPs and ORLs is the same (154,155). Both countries are divided into five hospital catchment areas (Figures 4 and 5).

In both countries, the number of children attending day care is similarly high (156,157) – in Finland, about 35% of children attend day care and in Norway about 45% (155) – and more than 60% of

Table 4. Studies on adenoidectomy rates.

Study	Year	Country	Age (years)	Rate (per 1000 children)	Findings
Andersen et al. (147)	1930-1950 birth cohort	Denmark	Preschool and school-aged children	-	Relative incidence 1.1
Wennberg et al. (149)	1969 1970 1971 1972 1973	Vermont/USA	0-14	0.9/0.7 1/0.8 1.2/0.9 2/1 2.4/1.1	Increasing trend National variation
Rosenfeld et al. (148)	1978-1986	USA	all	-	Decreasing trend
Derkay (100)	1978 1987	USA	0-14	1.6 0.3	Decreasing trend
Close et a. (146)	1986 1989/90	Australia	0-14	5.6 6.3	Increasing trend
Bisset (135)	1990 1994	Scotland	0-15	0.7- 4.1* 0.3-3.5*	National variation
Rob et a.l (38)	1981-1983 1986-1993 1994-1999	Australia	0-14	7.3-5.2 5.5-6.9 6.0-6.0	Decreasing trend
Schilder et al. (9)	1998	Finland Netherlands Scotland England and Wales USA Australia Canada	0-14	12.9 10.1 5 4 2.5 2.4 1.7	International variation

*adenoidectomy with tympanostomy tubes

Table 5. Studies on tonsillectomy rates.

Study	Year	Country	Age (years)	Rate (per 1000 children)	Findings
Glover (3)	1895-1937	England	School children	-	National variation Increasing and decreasing trends
Andersen et al. (147)	1930-1950 birth cohort	Denmark	Preschool and school-aged children	-	Relative incidence 0.7
Freeman et al. (113)	1970 1977	USA	0-4 5-8 9-14 0-4 5-8 9-14	0.2 0.5 1.2 0.3 0.7 1.5	Decreasing trend in total rates
McPherson et al. (10)	1975-1977	USA Norway England	All	2.9 0.6 1.7	International variation
Friedman et al. (150)	1975 1984	England	0-9	0.8 0.9	Increasing trend
Derkay (100)	1978 1987	USA	0-14	1.0 0.6	Decreasing trend
Rosenfeld et al. (148)	1978-1986	USA	All	-	Decreasing trend
Blais (12)	1985-1988	Canada	All	-	National variation
Close et al. (146)	1986 1989/90	Australia	0-14	5.1 5.3	Increasing trend
Bisset et al. (11)	1990	Scotland	0-15	3.6-8.0	National variation
Vestergaard et al. (112)	1980-2001	Denmark	4 (boys) 4 (girls)	9.7* 6.7*	Cumulative risk for tonsillectomy increased
Rob et al. (38)	1981-1983 1986-1992/3 1993/4-1998/9	Australia	0-14	6.4-4.1 4.9-5.8 5.2-5.5	Increasing trend

* per 1000 person-years

Table 6. Studies on (adeno)tonsillectomy rates.

Study	Year	Country	Age (years)	Rate (per 1000 children)	Findings
Pearson et al. (137)	1961-1964	Sweden England New England	0-14	4% * 14% * 38% *	International variation
Bloor et al. (138-9)	1961 1970	Scotland region 1 Scotland region 2	0-14	20.4- 13.0 18.7-18.1	National variation
Vayda et al. (140)	1968	Canada	All men All women	4.7-11.7 5.9-11.9	National variation
Wennberg et al. (149)	1969 1970 1971 1972 1973	Vermont / USA	0-14	12.9 / 13.6 12.8 / 13.2 10.6 / 12.8 0.8 / 1.2 0.7 / 11.7	Decreasing trend National variation
Freeman et al. (113)	1970 1977	USA	0-4 5-8 9-14 0-4 5-8 9-14	9.8 22.6 6.5 6.3 13.4 3.8	Decreasing trend
Roos et al. (141)	1973	Canada	0-14	8.1-16.4	National variation
Wennberg (144)	1975	USA	All	-	National variation
Perrin et al. (151)	1972 1981	USA	0-14	836 000 ** 475 500 **	Decreasing trend
Vayda et al. (142)	1973 1975 1977	Canada	All	2.7-9.9 1.9-8.8 2.0-8.1	National variation
Derkay (100)	1977 1987	USA	0-14	2.9 1.0	Decreasing trend
Rosenfeld et al. (148)	1978 1986	USA	All	282 ** 135 **	Decreasing trend
Black (134)	1976 1990	England	0-9	65% *** 30% ***	National variation Decreasing trend
Newton et al. (143)	1979-1986	England	All	2.0	National variation

Study	Year	Country	Age (years)	Rate (per 1000 children)	Findings
Close (146)	1986 1989/90	Australia	0-14	2.9 3.0 0.7 **** 0.9 ****	Increasing trend
Bisset (135)	1990 1994	Scotland	0-15	0.2-0.8 ****	National variation Decreasing trend
Owings et al. (145)	1996	USA	0-14	5	-
van den Akker et al. (8)	1998	Northern Ireland Netherlands Belgium Australia England USA Scotland Finland Canada	0-14	11.8 11.5 10.1 7.5 6.5 5 4.7 4.5 1.9	International variation

* proportion of children operated on
** absolute number
*** proportion of all otitis media with effusion operations
**** tonsillectomy ± adenoidectomy with insertion of tympanostomy tubes

Table 7. Comparison of Finland and Norway.

	Finland 1999	Norway 1999	Finland 2005	Norway 2005
Population	5 171 302	4 445 329	5 255 580	4 606 363
Number of children under 8 years	494 636	486 159	457 453	470 929
Number of working doctors	14 280	14 665	15 731	15 206
Number of working otorhinolaryngologists	250	276	290	274
Number of working general practitioners	3417	3471	3564	4191
Funding of health care (% of gross domestic product)	6.8	9.3	7.5	9.1

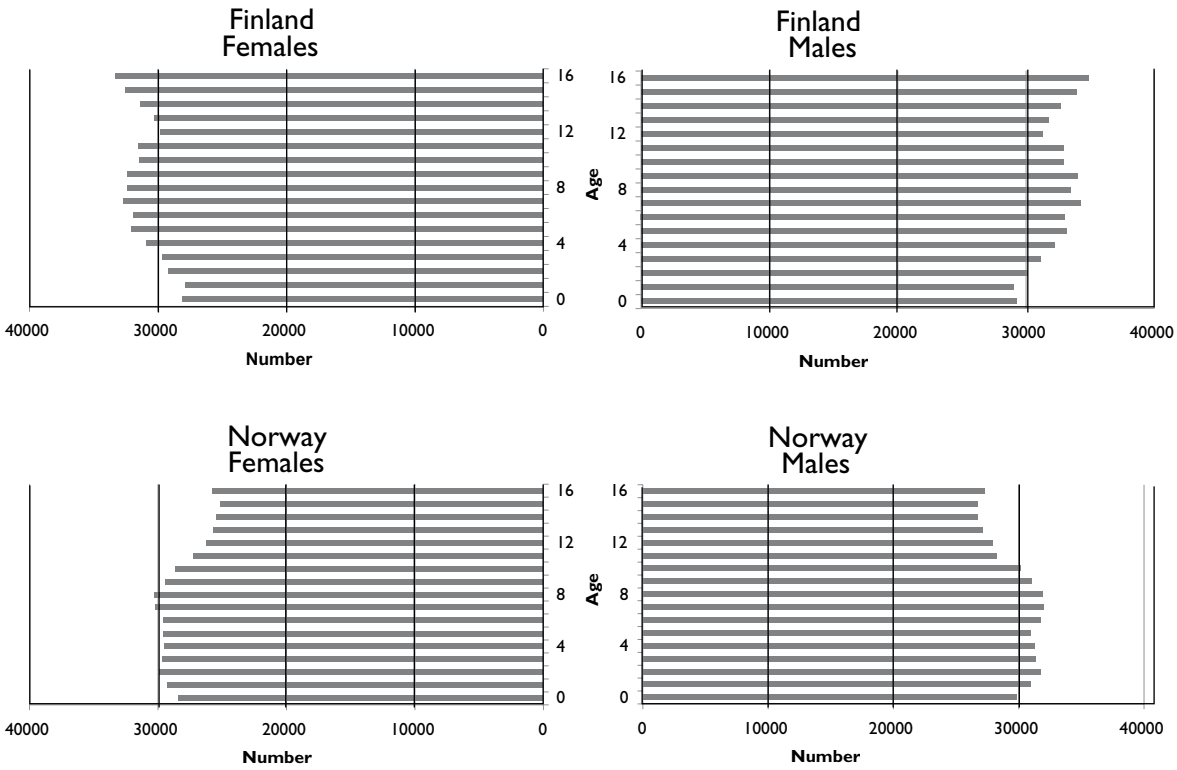

Figure 3. Population pyramids in Finland and Norway in 1999.

mothers with small children work outside the home (158,159). The exact rate of allergy in these countries is unknown, but IgE positivity of Finnish school-aged children is 22% (160), and one of four school-aged children in Norway is skin prick-positive (161). The average number of children per woman is 1.75 in Finland and 1.8 in Norway (155). Altogether 80% of children are still breastfed at six months of age in Norway, whereas in Finland the proportion is lower, only 60% (155). In Finland, 35%, of mothers and 46% of fathers

of children who had undergone tympanostomy tube operations smoked tobacco (162). Another study showed that 23% of Finnish households expose their children regularly to environmental tobacco smoke (163); however, Finnish parents were more likely than all other Nordic parents to protect their children from environmental tobacco smoke. In Norway, 18% of three-year-olds are exposed to passive smoking (164), and 67% of all Norwegian households expose their children regularly to environmental tobacco smoke (163). Similarities between Finland and Norway make these two countries highly comparable.

Differences between Finland and Norway also exist. In Finland, the state financing of hospital services is not based on the activities of hospitals, whereas in Norway revenues from the state are related to inpatient admissions (165). In Norway, the funding of the health care system was changed in 1999, when global budgeting was partially replaced by activity-based funding to improve productivity and reduce waiting lists (152). Finland does not have a corresponding health care funding strategy (153). Access to hospitals and waiting lists are differently organized. With the exception of those in need of immediate treatment, all Norwegian patients referred to public hospitals for out- or inpatient treatment are placed on a priority waiting list according to type of disease (152). Childhood OM is given a priority level that guarantees all children an appointment within three months. A corresponding system was introduced in Finland for the first time in March 2005, guaranteeing the right to treatment within 3-6 months (166). Although some differences exist in the health care systems, Finland and Norway are fairly comparable.

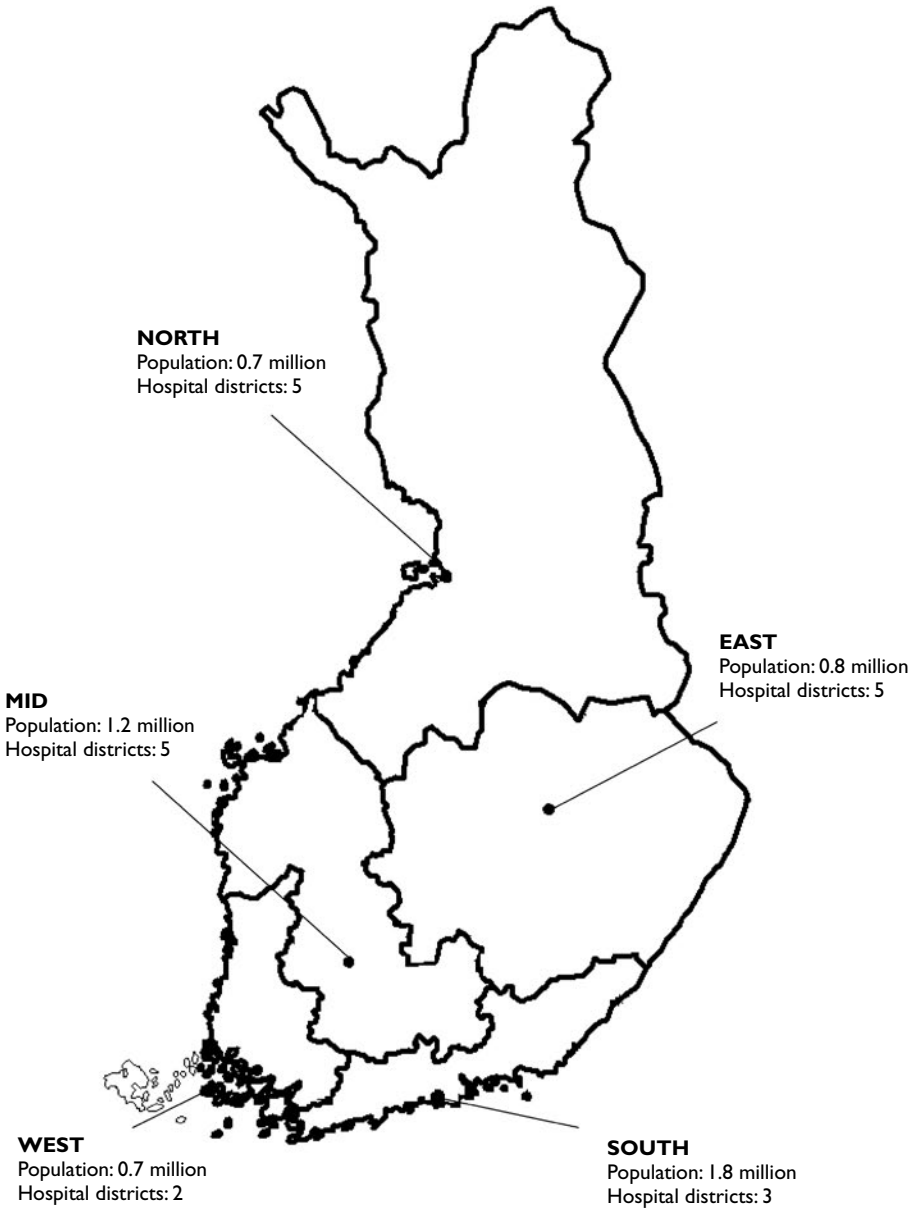

Figure 4. The five catchment areas of Finland.

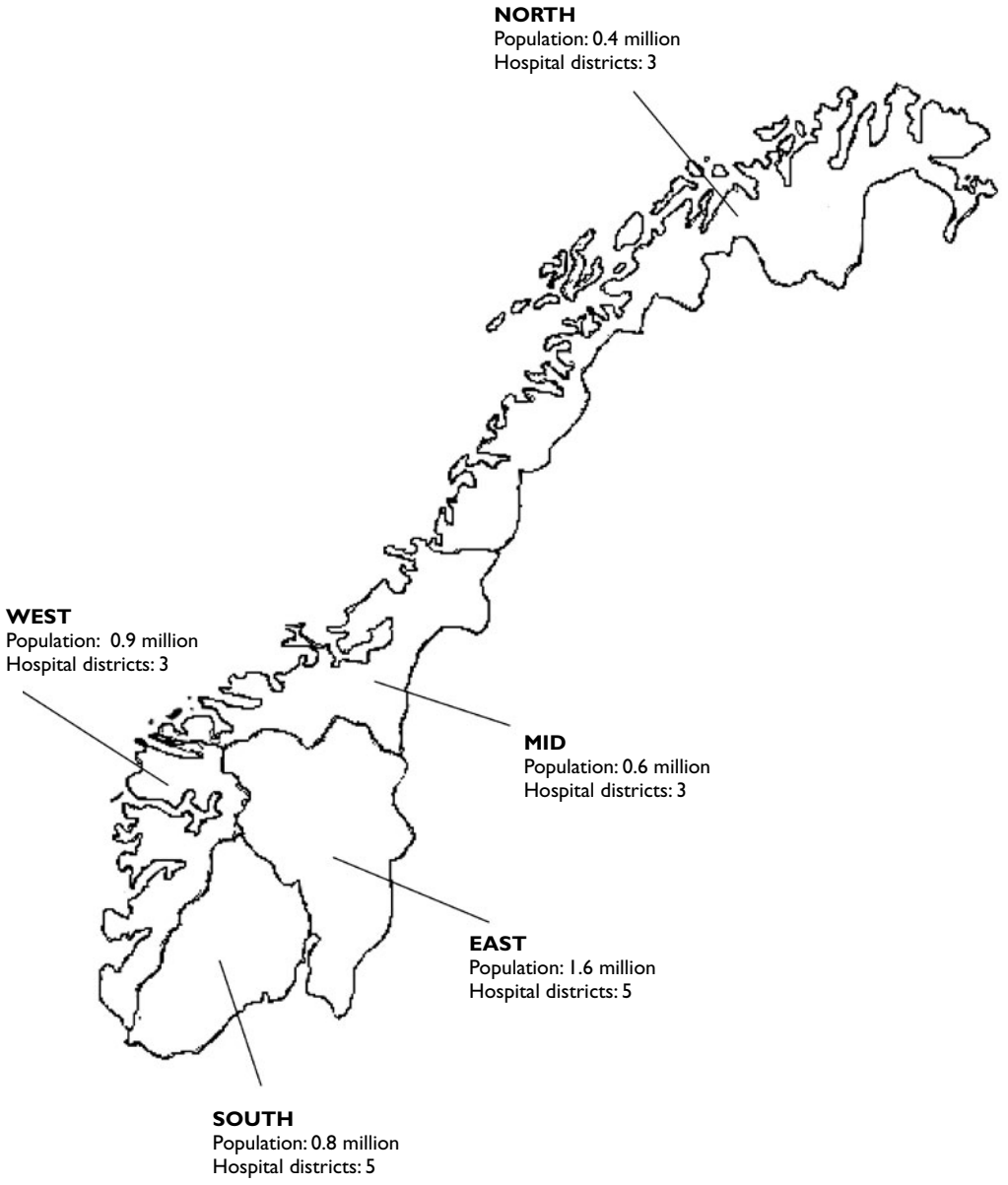

Figure 5. The five catchment areas of Norway.

3. Aims of the study

The purpose of this study was to assess paediatric upper respiratory surgery rates (adenoidectomy, tympanostomy tubes and (adeno)tonsillectomy) within and between Finland and Norway.

The specific questions addressed were as follows:

1. Were any differences present in national paediatric upper respiratory surgery rates between different catchment areas in Finland and Norway in 2002?

2. Were any international differences observed in paediatric upper respiratory surgery rates between Finland and Norway in 2002?

3. Were any differences present in paediatric upper respiratory surgery rates within and between Finland and Norway from 1999 to 2005?

4. Materials and methods

All studies were retrospective, descriptive studies based on public national registries. Data on surgery rates were collected from Finnish National Research and Development Centre for Welfare and Heath (STAKES) (167) and Norwegian Patient Registry (NPR) (168), population data were obtained from Statistics Finland (169) and Statistics Norway (159) and data on physicians were collected from the Finnish Medical Association (170) and the Norwegian Medical Association (171). The age, gender and distribution of the paediatric population and the age, gender and distribution of GPs and ORLs were studied as explanatory factors. Methods are described in detail in the original papers (I-V). The study protocol was approved by the Data Inspectorate of Norway.

4.1 Study designs

In Study I, surgery rates were estimated as the number of adenoidectomies and tympanostomy tubes per 10 000 children aged less than 16 years in 1987 and in 2002 in Finland. The year 1987 was chosen for comparison as it was the first year with adequate data available. The rates were compared in relation to child distribution, age, gender and the number and distribution of GPs and ORLs in five catchment areas in Finland.

In Study II, the rates of myringotomy, tympanostomy tubes and combination of adenoidectomy and myringotomy/tympanostomy tubes per 10 000 children were assessed in children aged less than

17 years in Norway in 2002 and compared with diagnoses at the time of surgery. No earlier year was chosen for comparison as adequate data was available from only 1997 onwards. The surgery rates were compared between the five catchment areas in Norway.

In Study III, the rates of adenoidectomies and tympanostomy tubes per 10 000 children aged less than 17 years in 2002 were assessed in light of child density, age, gender and the number and distribution of ORLs in Finland and Norway.

In Study IV, the rates of adenoidectomy, tympanostomy tube insertions and combination of these two were assessed from 1999 to 2005 in Finland and Norway. Analyses were restricted to children aged less than eight years. Surgical rates were viewed in light of child density, age, gender and total surgery rates, and the numbers were compared between the two countries.

In Study V, the rates of adenoidectomy, tonsillectomy and adenotonsillectomy were assessed from 1999 to 2005 in Finland and Norway. Analyses were restricted to children aged less than eight years. Surgery rates were viewed in light of child density, age, gender and total surgery rates, and the numbers were compared between the two countries.

4.2 Materials

4.2.1 Patients and the general population

Information about the general population, geographical distribution, age and gender was collected from the public registers, Statistics Finland (169) and Statistics Norway (159).

The origins of Statistics Finland date back to 1865, when the independent Statistical Office of Finland was founded. Before this, the organization belonged to Sweden. The organization operates under the Ministry of Finance, and its tasks are to compile statistics and reports concerning social conditions and to develop the national statistical service. The tasks are defined in the Statistics Finland Act, 1992.

Statistics Norway was founded in 1876, and it operates under the Ministry of Finance. Statistics Norway provides information about the structure and development of society, and its tasks are defined in the Statistics Act, 1989.

4.2.2 Physician rates

Information about the numbers of GPs and ORLs, their geographical distribution, age and gender was collected from the Finnish Medical Association (170) and the Norwegian Medical Association (171).

The Finnish Medical Association was founded in 1910. Membership is voluntary, but nearly all physicians who practice in Finland are members. The Finnish Medical Association represents the

medical community in Finland and has roughly 18 000 members. The association annually conducts a survey of the number, distribution, age gender and specialization of physicians (Lääkärikysely).

The Norwegian Medical Association was founded in 1886 and has roughly 25 000 members. The association collects cross-sectional and longitudinal data on the number, distribution, age, gender and specialization of physicians.

4.2.3 Surgery rates

The rates of adenoidectomy (ICD-10 code EMB30), tympanostomy tubes (ICD-10 code DCA20), tonsillectomy (ICD-10 code EMB10) and adenotonsillectomy (ICD-10 code EMB20) were obtained annually from 1999 to 2005 and in 1987 from STAKES (167) and from 1999 to 2005, also including rates of myringotomy (ICD-10 code DCA10) from NPR (168).

STAKES is specialized in the field of social welfare and health care, and it functions under the Ministry of Social Affairs and Health in Finland. Previous hospital discharge records have been maintained by STAKES since its founding in 1992. Both private and public hospitals and clinics are obliged to report patient-related diagnoses and procedure codes to the research institute. Diagnoses are coded according to the International Classification of Diagnoses (ICD-10) (172), and procedures are coded according to the Nordic Classification of Surgical Procedures (NCSP) (173). Data from all clinics are transferred once a year to STAKES.

NPR was established in 1997. It has been part of the Norwegian Directorate of Health and Social Services since 2007. All

public and private hospitals and clinics financially supported by the government provide information to NPR. Each clinic sends admittance and discharge diagnoses and codes of all medical and surgical procedures to the registry. Diagnoses are coded according to the ICD-10 (172), and procedures are coded according to the NCSP (173). Data from all Norwegian clinics are transferred once a year to NPR.

4.3 Statistical analysis

In Study I, age-specific surgery rates (EMB30 and DCA20) were viewed in the study population as measures of surgery occurrence. Rates were estimated as the proportion of adenoidectomies and tympanostomy tubes per 10 000 children aged less than 16 years in different age groups and genders. The statistical significance between the explanatory factors, such as the age and gender of the physician and the paediatric population, were calculated using Pearson's χ^2-test, Spearman rank correlation and paired t-test.

In Study II, surgery rates (DCA10, DCA20 and combinations of EMB30 with DCA10 or DCA20) were viewed in the study population as measures of surgery occurrence. These operations were considered OM surgery. Rates were estimated as the proportion of myringotomies, tympanostomy tubes or combinations of adenoidectomies with myringotomies or tympanostomy tubes per 10 000 children aged less than under 17 years in different age groups and genders and between different catchment areas. The operative procedures were compared with diagnoses at time of surgery. Diagnoses

were grouped as OM (ICD-10 codes H65-H66), chronic disease of tonsils and adenoid (ICD-10 code J35) and other diagnoses. Rates of surgery were compared with the geographical distribution of ORLs. To define the probability of having an operation (DCA10, DCA20 or combination of EMB30 with DCA10 or DCA20), gender- and age-adjusted odds ratios (ORs) with 95% confidence intervals (95% CIs) were calculated for the surgical procedures by multiple logistic regressions. No difference between the crude and adjusted ratios was found so only adjusted ratios were used.

In Study III, total rates of EMB30 and DCA20 were compared between Finland and Norway. The rates were also estimated per 10 000 children aged less than 17 years and compared with age and gender. Surgery rates between different catchment areas were estimated and compared with the number of ORLs. ICD-10 diagnoses for acute and chronic OM (H65, H66 and H67 with sub-grouping) were used for children aged less than three years for estimating the national rates of OM diagnoses.

In Study IV, surgery rates (EMB30 and DCA20 and combinations of these) were estimated as the proportions of operations per 10 000 children aged less than eight years in different age groups and genders annually from 1999 to 2005. Statistical significance between genders and ages was calculated using Pearson's χ^2-test. The same test was used to estimate the difference in surgery rates between Finland and Norway. To define the probability of having adenoidectomy or tympanostomy tubes, gender- and age-adjusted odds-ratios (ORs) with 95% confidence intervals (95% CIs) were calculated for

the surgical procedures by multiple logistic regressions.

In Study V, surgery rates (EMB10, EMB20 and EMB30) were estimated as the proportion of operations per 10 000 children aged less than eight years in different age groups and genders annually from 1999 to 2005. The statistical significance between genders and age groups was calculated using Pearson's x^2-test. The same test was used to estimate the difference in surgery rates between Finland and Norway.

Statistical analyses were performed with NCSS Statistical Software 2004 (NCSS Inc., Kaysville, UT, USA) and the Statistical Software Package for Social Sciences, version 12.0.1, for Windows (SPSS Inc., Chicago, IL, USA). A p-value of 0.05 was considered significant.

5. Results

5.1 National variation

In 2002, rates of adenoidectomy and tympanostomy tubes varied between different catchment areas in Finland (Figure 4). The difference was largest between the Eastern and Western catchment areas. Adenoidectomies were performed 1.85 times as frequently in Western Finland as in Eastern Finland. Tympanostomy tubes were 2.3 times more common in Western Finland than in Eastern Finland (Table 8a). The difference was especially high in children aged less than 2 years. The incidence of adenoidectomies in Finland increased from 1987 to 2002 (Study I).

In Norway, a large variation in surgery rates between different catchment areas (Figure 5) was observed in 2002. The difference for adenoidectomy with myringotomy or tympanostomy tubes was largest between the Northern and Mid-catchment areas; the operation was performed 1.9 times more often in Northern Norway. The difference for tympanostomy tubes was largest between the Southern and Eastern catchment areas; operations were performed 2.9 times more often in Southern Norway. Overall, the difference in OM surgery (myringotomy, tympanostomy tubes and adenoidectomy with myringotomy or tympanostomy tubes) was largest between Eastern and Northern catchment areas (Table 8b) (Study II).

No association between the national variation of upper respiratory surgery rates and the number of GPs, ORLs or the age or gender of the physician was found in either country.

5.2 International variation

Surgery for OM (adenoidectomy and/or tympanostomy tubes) varied greatly between Finland and Norway in 2002 (Figure 6). Adenoidectomies were performed 2.5 times more frequently in Finland than in Norway in children aged less than 17 years. Tympanostomy tubes were inserted 1.2 times more often in Finland than in Norway. The rates of surgery for OM were compared with the proportion of ORLs, but no relation was found. An inverse relationship was observed between the density of children and the proportion of surgeries in both countries (Study III).

5.3 Trends in rates of adenoidectomies, tympanostomy tubes and (adeno)tonsillectomies

The incidence of adenoidectomies in Finland decreased by 37% from 1999 to 2005. The rates of tympanostomy tubes increased by 52% from 1999 to 2005, while tonsillectomy and adenotonsillectomy rates remained unchanged.

Table 8a. Rates of adenoidectomy and tympanostomy tubes and the number of otorhinolaryngologists (ORLs) in different catchment areas of Finland.

FINLAND (rates per 10 000 children aged less than 16 years) Catchment area	Adenoidectomy	Tympanostomy tubes	ORLs
Western	139	77	3.3
Eastern	75	33	2.6
Northern	89	63	2.5
Mid	90	54	2.2
Southern	95	43	3.0

Adenoidectomy rates decreased by 48% and tonsillectomy by 29% in Norway from 1999 to 2005. The rates of tympanostomy tubes increased by 3% and adenotonsillectomies by 30% for the same period.

A difference in adenoidectomy, tonsillectomy and adenotonsillectomy rates between Finland and Norway was found from 1999 to 2005. Despite a strong decreasing trend adenoidectomy rates remained higher in Finland. Tonsillectomy and adenotonsillectomy rates remained higher in Norway, but the difference was not as striking as for the adenoidectomy rates. The difference in the rates of tympanostomy tubes was minor between the two countries. The total rate of upper respiratory surgery remained higher in Finland than in Norway throughout the study period, but the rates began converging, mainly because of the decrease in adenoidectomy rates in Finland.

In Finland, operated children were much younger throughout the study period than in Norway. The peak age for adenoidectomy was the second year of life in Finland (no variation), while in Norway it was the fifth year of life (variation from fifth to sixth year

Table 8b. Rates of adenoidectomy with tympanostomy tubes or myringotomy and tympanostomy tubes and the number of otorhinolaryngologists (ORLs) in different catchment areas of Norway.

NORWAY (rates per 10 000 children aged less than 17 years) Catchment area	Adenoidectomy (+ myringotomy / tympanostomy tubes)	Tympanostomy tubes	ORLs
Western	20	55	2.3
Eastern	26	20	3.4
Northern	35	58	2.5
Mid	18	48	2.5
Southern	20	58	1.8

of life). The peak age for tympanostomy tubes was the second year of life in Finland (no variation), and in Norway the sixth year of life (variation from fifth to seventh year of life). Variation in the peak age for (adeno)tonsillectomies was weaker. The peak ages for adenoidectomy, tympanostomy tubes and (adeno)tonsillectomy in Finland and in Norway in 1999 are presented in Figure 7.

Boys were operated on significantly more often throughout the study period ($p<0.05$) both in Finland and Norway. Boys had an increased risk for adenoidectomy (OR 1.3) and tympanostomy tubes (OR 1.5) (Studies IV and V).

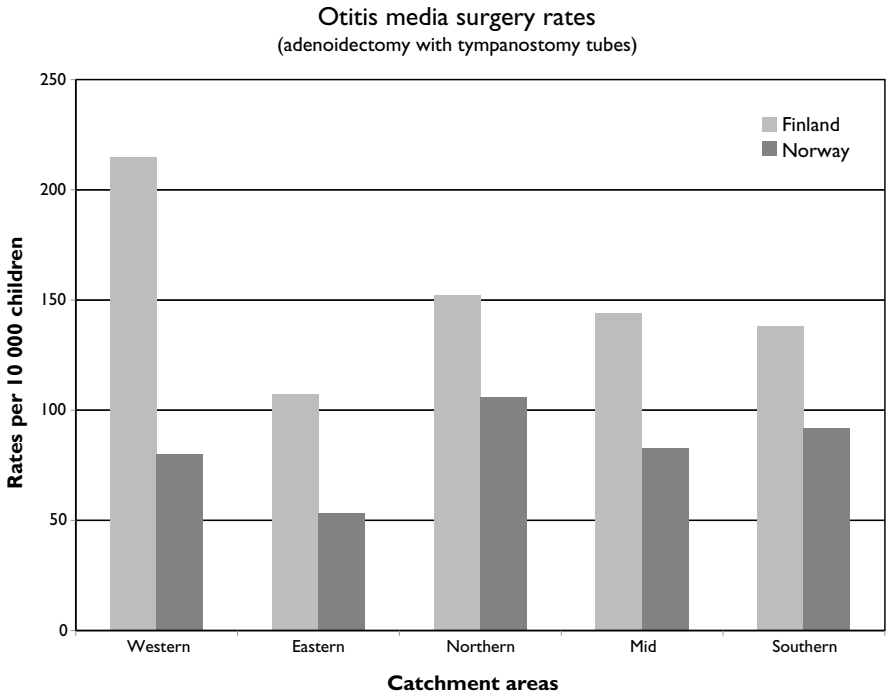

Figure 6. Otitis media surgery (adenoidectomy with tympanostomy tubes) rates in Finland and Norway in 2002.

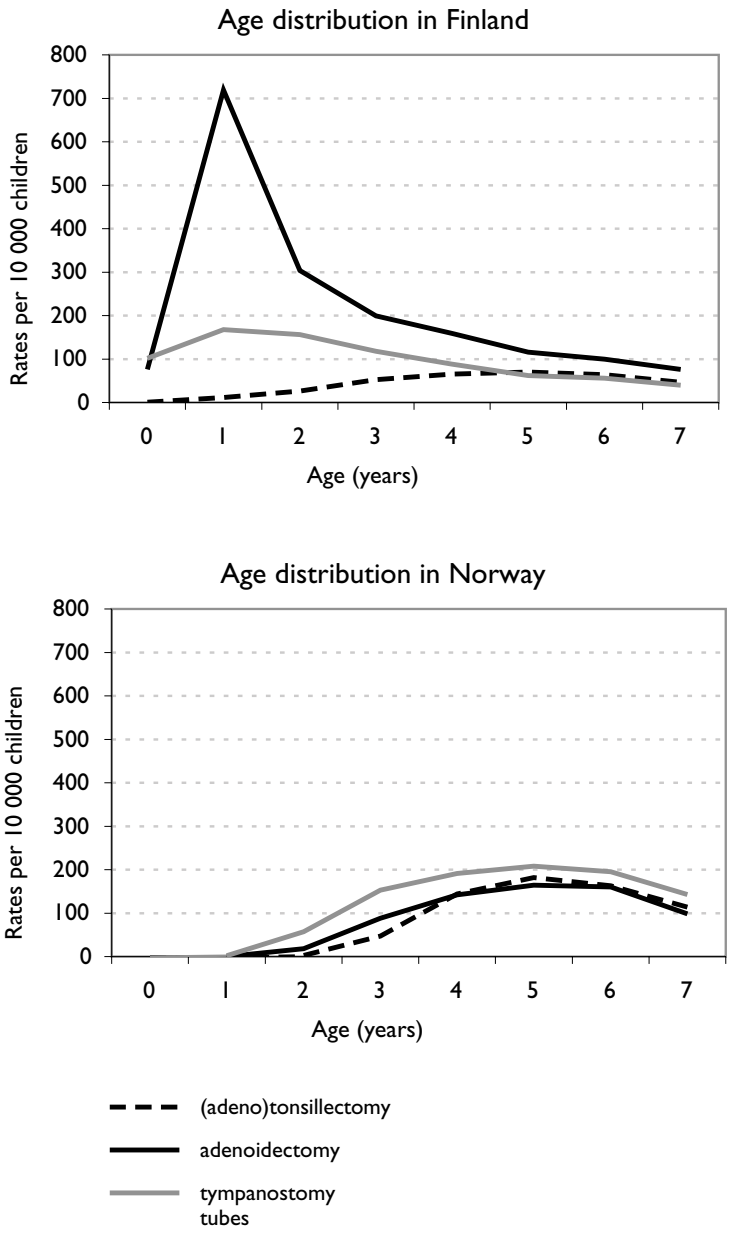

Figure 7. Age distribution of adenoidectomy, (adeno)tonsillectomy and tympanostomy tubes per 10 000 children in Finland and Norway in 1999.

6. Discussion

Large variability in upper respiratory surgery rates was revealed both within and between Finland and Norway.

National variation in Finland and Norway was discovered between different catchment areas. National guidelines to support evidence-based medicine and improve patient care in OM and tonsillitis have been implemented in both countries. Adherence to the guidelines has, however, been questioned (174,175). Approximately 80% of physicians are aware of the guidelines (176), yet few seem to follow them (18,19,111,177). The implementation of national guidelines in Finland in 1999 has had an effect on national rates of adenoidectomies and tympanostomy tubes, but a large variation in national operation rates remains.

The variation arises in part from primary health care, where the everyday routine is quite different from the evidence-based recommendations for the diagnosis and treatment of common upper respiratory infections. As an example, tympanometry is recommended in the diagnostics of AOM, but it was used as a diagnostic test in only 1% of AOM episodes (178). A significant reduction in AOM diagnoses could be achieved by adhering to diagnostic criteria (179). Prediction of AOM with symptoms and signs alone is unreliable (180), and GPs tend to overdiagnose AOM (181). When a child is referred to specialists, the practice often departs from recommendations (18,19,34). A rise in AOM diagnoses strongly increases operative treatment rates (37). If guidelines are followed, a child is referred to a specialist only after three or four OM episodes.

Although the treatment of tonsillitis is simpler, it has its own problems. Throat culture, antigen detection or both are recommended to diagnose tonsillitis, and these have been reported to be used in 57% of throat infections (178). However, the problem with (adeno)tonsillectomies does not lie in the operations conducted with recurrent GABHS indication, but in most operations being conducted with unestablished indications (21). Variation in how national guidelines are followed in different parts of countries may lead to large national variation, which was the case in both Finland and Norway.

Differences in upper respiratory surgery rates declined in the two countries between 1999 and 2005. The variation overall appears to be diminishing, but further studies are needed to confirm this.

The most striking differences between Finland and Norway were in adenoidectomy rates and the age distribution of operated children. Finnish children are being operated on at very young ages compared with Norway. One can speculate that in Finland children are treated for AOM and in Norway for chronic OME, and some children are overtreated while others are undertreated.

Adenoidectomy has been immensely popular in Finland – every fifth Finnish child is estimated to have had an adenoidectomy (182). Our findings support this estimation. Finland and Norway resemble each other in the form and use of day care. The Finnish government subsidizes parental leave until a child is nine months, 44 weeks at 60% pay. In Norway, parents get 54 weeks at 80% pay or 44 weeks with full pay when a child is born. This means Finnish children are likely to start day care at a centre three months earlier than Norwegian children.

One of the most important risk factors for OM is attending day care, which is widely popular in Finland and Norway. Day care outside the home has been suggested to increase the number of tympanostomy tube insertions by 58% in Finland (99). At the beginning of the 1990s, when the local authorities in Finland were obliged by law to arrange day care for all children aged less than three years, the number of adenoidectomies performed on this age cohort increased by 30% (99).

Mothers working outside the home are more likely than other mothers to seek medical care for minor symptoms (183). Parents tend to seek medical advice for mild signs and symptoms, especially in young children (184). By providing education, this could be avoided. A simple hygiene programme in day care centres decreases the number of upper respiratory infections (185), and group sizes resembling family care would decrease the number of OM episodes in children (186). This could lead to a decrease in upper respiratory surgery rates. Unnecessary operations should be avoided since surgical procedures involve psychological trauma, anaesthetic risk and risks for other complications (34). Parents are often eager to get surgical treatment for their children in a search for the best possible treatment. However, sometimes the best treatment is watchful waiting. Education is needed for parents about the advantages and disadvantages of paediatric upper respiratory surgery.

Nevertheless, mothers working outside the home and children attending day care centres are common in both Finland and Norway (156-158), and this does not explain the difference in age distribution.

Boys were operated on more frequently in both countries, a finding previously reported many times. Boys are more prone to have upper respiratory infections (187), which may lead to more AOM episodes, more hospitalization (188) and more upper respiratory operations.

No clear reason for the variation in paediatric upper respiratory rates was found within or between Finland and Norway. Previous studies have been unable to explain the variation in surgical practices (138,139,141). Variation in surgery rates has been proposed to be created by differences in medical practices, rather than being the result of differences in disease incidence (12,138,139). In procedures with clear indications and no conservative treatment options, such as operations on inguinal hernias, variation in the clinical picture is small. For procedures without professional consensus on indications and outcome, the variation in clinical practice tends to be large (10,22). This may underlie the national and international differences observed between Finland and Norway.

The study design allowed a thorough assessment of the number and distribution of upper respiratory surgery and its national and international variation but not for more. Use of registry data is not without problems, as it lacks supplemental clinical records and follow-up information. At present, patient identification is not possible from this data, so the possibility for the same patient to receive the same operation several times within a year exists but cannot be confirmed. Validation of registry data by medical charts has not been published for upper respiratory infection diagnoses or procedures in Finland or Norway. Evaluation of the Finnish discharge register revealed a 70% match between surgical procedures and medical

records, while accuracy of the record overall was 95% (189,190). In Norway, procedures for extrauterine pregnancy have shown a good correlation between NPR data and medical patient charts (191), but the NPR underestimated the proportion of hip fractures receiving surgical treatment (192). Differences in coding, especially in diagnosis codes, may influence the outcome. The way surgeons select different diagnoses may be inaccurate and can be influenced by many factors. This is why procedural codes were used in the studies. Possible mistakes and inaccuracy in analysed data are not likely to markedly change these results.

The proportion of operations performed in the private sector could not be evaluated from this data. In both countries, the private sector also exists and performs operations frequently. Socio-economic disparities are present in the rates of many common surgical procedures in Finland (193) and could explain some of the national variation. Nevertheless, in both countries, treatment for paediatric upper respiratory morbidities is of high priority, and generally, the waiting time for operations is short and the accessibility is good.

The study settings had some limitations. The age groups differed between different studies and data collection settings were different. The age groups in the first three studies included the whole paediatric population. Trend analyses were, however, limited to children aged less than 8 years, the age group where adenoidectomies and tympanostomy tubes are most common. Because the findings were so strong possible inaccuracies in data are not anticipated to have a marked effect.

7. Conclusion

1. A large variation in paediatric upper respiratory surgery rates was found between different catchment areas in both Finland and Norway in 2002.
2. A large variation in paediatric upper respiratory surgery rates was observed between Finland and Norway in 2002.
3. (Adeno)tonsillectomy and tympanostomy tube rates had only moderate changes throughout the study period, while a marked decrease occurred in Finnish adenoidectomy rates from 1999 to 2005, explaining the converging upper respiratory surgery rates in children between Finland and Norway.

Analysing surgery rates and comparing the results both nationally and internationally are a good start in rationalization of treatment in paediatric morbidities. Children are entitled to just and uniform treatment for common diseases. Surgery is beneficial when directed to the right population of children. The problem remains of how to identify those children in need of surgery. To this end, further international collaboration and large-scale studies are needed. National intervention studies should also be conducted. Awareness of variability in clinical practice is the first step in correcting and unifying standards for paediatric upper respiratory surgery.

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References

(1) Gates GA. Otitis media--the pharyngeal connection. JAMA 1999;282:987-989.
(2) Bodner EE, **Browning GG**, **Chalmers FT**, **Chalmers TC**. Can meta-analysis help uncertainty in surgery for otitis media in children. J.Laryngol.Otol. 1991;105:812-819.
(3) Glover JA. The incidence of tonsillectomy in school children. Proc. R. Soc. Med. 1938:1219-1236.
(4) Paradise JL, **Bluestone CD**, **Colborn DK**, **Bernard BS**, **Rockette HE**, **Kurs-Lasky M**. Tonsillectomy and adenotonsillectomy for recurrent throat infection in moderately affected children. Pediatrics 2002;110:7-15.
(5) Mattila PS. Adenoidectomy and tympanostomy tubes in the management of otitis media. Curr.Allergy Asthma Rep. 2006;6:321-326.
(6) Rovers MM, **Balemans WA**, **Sanders EA**, **van der Ent CK**, **Zielhuis GA**, **Schilder AG**. Persistence of upper respiratory tract infections in a cohort followed from childhood to adulthood. Fam.Pract. 2006;23:286-290.
(7) van Staaij BK, **van den Akker EH**, **van der Heijden GJ**, **Schilder AG**, **Hoes AW**. Adenotonsillectomy for upper respiratory infections: evidence based? Arch.Dis.Child. 2005;90:19-25.
(8) Van Den Akker EH, **Hoes AW**, **Burton MJ**, **Schilder AG**. Large international differences in (adeno)tonsillectomy rates. Clin. Otolaryngol. 2004;29:161-164.
(9) Schilder AG, **Lok W**, **Rovers MM**. International perspectives on management of acute otitis media: a qualitative review. Int. J.Pediatr.Otorhinolaryngol. 2004;68:29-36.
(10) McPherson K, **Wennberg JE**, **Hovind OB**, **Clifford P**. Small-area variations in the use of common surgical procedures: an international comparison of New England, England, and Norway. N.Engl.J.Med. 1982;307:1310-1314.
(11) Bisset AF, **Russell D**. Grommets, tonsillectomies, and deprivation in Scotland. BMJ 1994;308:1129-1132.
(12) Blais R. Variations in surgical rates in Quebec: does access to teaching hospitals make a difference? CMAJ 1993;148:1729-1736.
(13) American Academy of Pediatrics Subcommittee on Management of Acute Otitis Media. Diagnosis and management of acute otitis media. Pediatrics 2004;113:1451-1465.
(14) American Academy of Pediatrics: The Otitis Media Guideline Panel. Managing otitis media with effusion in young children. Pediatrics 1994;94:766-773.
(15) Norwegian Society for Otorhinolaryngology. Veileder for fagområdet øre-, nese-, halssykdomme [Treatment guidelines] (Norwegian). 1997; Available at: http://www.legeforeningen.no/asset/25758/1/25758_1.doc.
(16) Puhakka H, **Hagman E**, **Heikkinen T**, **Huovinen P**, **Jero J**, **Karma P**, et al. [Treatment guideline for acute otitis media](Finnish). Duodecim 1999;115:2155-2161.
(17) Puhakka H, **Hagman E**, **Huovinen P**, **Mäkelä M**, **Ruuskonen O**, **Sairanen S**. Lapsen äkillinen välikorvatulehdus [Pediatric acute otitis media] (Finnish). Duodecim 1998;114:787.
(18) Keyhani S, **Kleinman LC**, **Rothschild M**, **Bernstein JM**, **Anderson R**, **Chassin M**. Overuse of tympanostomy tubes in New York metropolitan area: evidence from five hospital cohort. BMJ 2008;337:a1607.
(19) Keyhani S, **Kleinman LC**, **Rothschild M**, **Bernstein JM**, **Anderson R**, **Simon M**, et al. Clinical characteristics of New York City children who received tympanostomy tubes in 2002. Pediatrics 2008;121:e24-33.
(20) LoGerfo JP, **Dynes IM**, **Frost F**,

Diehr PK, **Richardson WC**. Tonsillectomies, adenoidectomies, audits: have surgical indications been met?. Med.Care 1978;16:950-955.
(21) van den Akker EH, **Schilder AG**, **Kemps YJ**, **van Balen FA**, **Hordijk GJ**, **Hoes AW**. Current indications for (adeno)tonsillectomy in children: a survey in The Netherlands. Int.J.Pediatr.Otorhinolaryngol. 2003;67:603-607.
(22) Keskimäki I, **Aro S, Teperi J**. Regional variation in surgical procedure rates in Finland. Scand.J.Soc.Med. 1994;22:132-138.
(23) Vuorma S, **Teperi J**, **Hurskainen R**, **Keskimäki I**, **Kujansuu E**. Hysterectomy trends in Finland in 1987-1995--a register based analysis. Acta Obstet.Gynecol.Scand. 1998;77:770-776.
(24) Mikkola H, **Järvelin J**, **Seitsalo S**, **Keskimäki I**. Ortopediset leikkaukset Suomessa 1987-2002. Leikkausmäärien alueelliset erot, jonotusajat ja keskittyminen. [Orthopaedic operations in Finland 1987-2002] (Finnish). Duodecim 2005;121:861-871.
(25) Lindekleiv H, **Due J**. Parathyreoideakirurgi i Norge 1999 - 2005 [Parathyroid surgery in Norway 1999-2005] (Norwegian). Tidsskr.Nor.Laegeforen. 2007;127:1181-1184.
(26) Bluestone CD, **Klein JO** editors. Otitis media in Infants and Children. 2nd ed. Philadelphia: WB Saunders Company; 1995.
(27) Howie VM, **Ploussard JH**, **Sloyer J**. The "otitis-prone" condition. Am.J.Dis.Child. 1975;129:676-678.
(28) Alho OP, **Koivu M**, **Sorri M**. What is an 'otitis-prone' child? Int.J.Pediatr.Otorhinolaryngol. 1991;21:201-209.
(29) Alho OP. How common is recurrent acute otitis media? Acta Otolaryngol.Suppl. 1997;529:8-10.
(30) Bondy J, **Berman S**, **Glazner J**, **Lezotte D**. Direct expenditures related to otitis media diagnoses: extrapolations from a pediatric medicaid cohort. Pediatrics 2000;105:E72.
(31) Teele DW, **Klein JO**, **Rosner BA**. Epidemiology of otitis media in children. Ann.Otol.Rhinol.Laryngol.Suppl. 1980;89:5-6.
(32) Alho OP, **Koivu M**, **Sorri M**, **Rantakallio P**. The occurrence of acute otitis media in infants. A life-table analysis. Int.J.Pediatr.Otorhinolaryngol. 1991;21:7-14.
(33) Paradise JL, **Rockette HE**, **Colborn DK**, **Bernard BS**, **Smith CG**, **Kurs-Lasky M**, et al. Otitis media in 2253 Pittsburgh-area infants: prevalence and risk factors during the first two years of life. Pediatrics 1997;99:318-333.
(34) Alho OP, **Koivu M**, **Sorri M**, **Oja H**, **Kilkku O**. Which children are being operated on for recurrent acute otitis media? Arch.Otolaryngol.Head.Neck.Surg. 1994;120:807-811.
(35) Suomalainen Lääkäriseura Duodecim, Suomen Lastenlääkäriyhdistys ry, Suomen Otolaryngologiyhdistys ry, Suomen Yleislääketieteen yhdistys ry. Äkillinen välikorvatulehdus [Treatment guideline: Acute otitis media] (Finnish). 2004; Available at: http://www.kaypahoito.fi.
(36) Joki-Erkkilä VP, **Pukander J**, **Laippala P**. Alteration of clinical picture and treatment of pediatric acute otitis media over the past two decades. Int.J.Pediatr.Otorhinolaryngol. 2000;55:197-201.
(37) Joki-Erkkilä VP, **Laippala P**, **Pukander J**. Increase in paediatric acute otitis media diagnosed by primary care in two Finnish municipalities--1994-5 versus 1978-9. Epidemiol.Infect. 1998;121:529-534.
(38) Rob MI, **Westbrook JI**, **Taylor R**, **Rushworth R**. Increased rates of ENT surgery among young children: have clinical guidelines made a difference? J.Paediatr.Child Health 2004;40:627-632.
(39) Pukander J, Luotonen J, **Timonen M**, **Karma P**. Risk factors affecting the occurrence of acute otitis media among 2-

3-year-old urban children. Acta Otolaryngol.1985;100:260-265.
(40) Alho OP, **Koivu M**, **Sorri M**, **Rantakallio P**. Risk factors for recurrent acute otitis media and respiratory infection in infancy. Int.J.Pediatr.Otorhinolaryngol. 1990;19:151-161.
(41) Froom J, **Culpepper L**, **Green LA**, **de Melker RA**, **Grob P**, **Heeren T**, et al. A cross-national study of acute otitis media: risk factors, severity, and treatment at initial visit. Report from the International Primary Care Network (IPCN) and the Ambulatory Sentinel Practice Network (ASPN). J.Am. Board Fam.Pract. 2001;14:406-417.
(42) L**ouhiala PJ**, **Jaakkola N**, **Ruotsalainen R**, **Jaakkola JJ**. Form of day care and respiratory infections among Finnish children. Am.J.Public Health 1995;85:1109-1112.
(43) Daly KA, **Brown JE**, **Lindgren BR**, **Meland MH**, **Le CT**, **Giebink GS**. Epidemiology of otitis media onset by six months of age. Pediatrics 1999;103:1158-1166.
(44) Rovers MM, **Zielhuis GA**, **Ingels K**, **van der Wilt GJ**. Day-care and otitis media in young children: a critical overview. Eur. J.Pediatr. 1999;158:1-6.
(45) Lubianca Neto JF, **Hemb L**, **Silva DB**. Systematic literature review of modifiable risk factors for recurrent acute otitis media in childhood. J.Pediatr. 2006;82:87-96.
(46) Etzel RA, **Pattishall EN**, **Haley NJ**, **Fletcher RH**, **Henderson FW**. Passive smoking and middle ear effusion among children in day care. Pediatrics 1992;90:228-232.
(47) Sipilä M, **Karma P**, **Pukander J**, **Timonen M**, **Kataja M**. The Bayesian approach to the evaluation of risk factors in acute and recurrent acute otitis media. Acta Otolaryngol. 1988;106:94-101.
(48) Black N. Causes of glue ear. An historical review of theories and evidence. J.Laryngol.Otol. 1985;99:953-966.
(49) Koivunen P, **Uhari M**, **Luotonen J**, **Kristo A**, **Raski R**, **Pokka T**, et al. Adenoidectomy versus chemoprophylaxis and placebo for recurrent acute otitis media in children aged under 2 years: randomised controlled trial. BMJ 2004;328:487.
(50) Rosenfeld RM, **Kay D**. Natural history of untreated otitis media. Laryngoscope 2003;113:1645-1657.
(51) Bluestone CD. Clinical course, complications and sequelae of acute otitis media. Pediatr.Infect.Dis.J. 2000;19:S37-46.
(52) Ghaffar FA, **Wordemann M**, **McCracken GH**,Jr. Acute mastoiditis in children: a seventeen-year experience in Dallas, Texas. Pediatr.Infect.Dis.J. 2001;20:376-380.
(53) Robinson RF, **Koranyi K**, **Mahan JD**, **Nahata MC**. Increased frequency of acute mastoiditis in children. Am.J.Health-Syst Pharm. 2004;61:304.
(54) Luotonen M, **Uhari M**, **Aitola L**, **Lukkaroinen AM**, **Luotonen J**, **Uhari M**, et al. Recurrent otitis media during infancy and linguistic skills at the age of nine years. Pediatr.Infect.Dis.J. 1996;15:854-858.
(55) Klausen O, **Moller P**, **Holmefjord A**, **Reisaeter S**, **Asbjornsen A**. Lasting effects of otitis media with effusion on language skills and listening performance. Acta Otolaryngol.Suppl. 2000;543:73-76.
(56) Luotonen M, **Uhari M**, **Aitola L**, **Lukkaroinen AM**, **Luotonen J**, **Uhari M**. A nation-wide, population-based survey of otitis media and school achievement. Int. J.Pediatr.Otorhinolaryngol. 1998;43:41-51.
(57) Roberts J, **Hunter L**, **Gravel J**, **Rosenfeld R**, **Berman S**, **Haggard M**, et al. Otitis media, hearing loss, and language learning: controversies and current research. J.Dev. Behav.Pediatr. 2004;25:110-122.
(58) Karma P, **Palva T**, **Kouvalainen K**, **Karja J**, **Mäkela PH**, **Prinssi VP**, et al. Finnish approach to the treatment of acute otitis media. Report of the Finnish Consensus Conference. Ann.Otol.Rhinol.

Laryngol.Suppl. 1987;129:1-19.
(59) Kvaerner KJ, **Mair IW**. Akutt og residiverende akutt otitis media [Acute and recurrent otitis media. Prevention and treatment in the light of current knowledge] (Norwegian). Tidsskr.Nor.Laegeforen. 1997;117:4096-4098.
(60) Arens R, **McDonough JM**, **Corbin AM**, **Hernandez ME**, **Maislin G**, **Schwab RJ**, et al. Linear dimensions of the upper airway structure during development: assessment by magnetic resonance imaging. Am.J.Respir.Crit.Care Med. 2002;165:117-122.
(61) Suomen Mikrobiologit ry, Suomen Yleislääketieteen yhdistys. Nielutulehdus [Treatment guideline: Acute pharyngitis] (Finnish). 1999; Available at: http://www.kaypahoito.fi.
(62) Bisno AL. Acute pharyngitis: etiology and diagnosis. Pediatrics 1996;97:949-954.
(63) Karevold G, **Kvestad E**, **Nafstad P**, **Kvaerner KJ**. Respiratory infections in schoolchildren: co-morbidity and risk factors. Arch.Dis.Child. 2006;91:391-395.
(64) Brook I, **Gober AE**. Persistence of group A beta-hemolytic streptococci in toothbrushes and removable orthodontic appliances following treatment of pharyngotonsillitis. Arch.Otolaryngol.Head.Neck.Surg. 1998;124:993-995.
(65) Van Staaij BK, **Van Den Akker EH**, **De Haas Van Dorsser,E.H.**, **Fleer A**, **Hoes AW**, **Schilder AG**. Does the tonsillar surface flora differ in children with and without tonsillar disease?. Acta Otolaryngol. 2003;123:873-878.
(66) Bell Z, **Menezes AA**, **Primrose WJ**, **McGuigan JA**. Mediastinitis: a life-threatening complication of acute tonsillitis. J.Laryngol.Otol. 2005;119:743-745.
(67) Shulman ST, **Gerber MA**, **Tanz RR**, **Markowitz M**. Streptococcal pharyngitis: the case for penicillin therapy. Pediatr.Infect.Dis.J. 1994;13:1-7.
(68) Goldstein NA, **Fatima M**, **Campbell TF**, **Rosenfeld RM**. Child behavior and quality of life before and after tonsillectomy and adenoidectomy. Arch.Otolaryngol.Head.Neck.Surg. 2002;128:770-775.
(69) Goldstein NA, **Post JC**, **Rosenfeld RM**, **Campbell TF**. Impact of tonsillectomy and adenoidectomy on child behavior. Arch.Otolaryngol.Head.Neck.Surg. 2000;126:494-498.
(70) Gozal D, **Capdevila OS**, **Kheirandish-Gozal L**. Metabolic alterations and systemic inflammation in obstructive sleep apnea among nonobese and obese prepubertal children. Am.J.Respir.Crit.Care Med. 2008;177:1142-1149.
(71) Rimmer J, **Giddings CE**, **Weir N**. History of myringotomy and grommets. J.Laryngol.Otol. 2007;121:911-916.
(72) Black NA. Is glue ear a modern phenomenon? A historical review of the medical literature. Clin.Otolaryngol.Allied Sci. 1984;9:155-163.
(73) Weir N. Otorhinolaryngology. Postgrad.Med.J. 2000;76:65-69.
(74) Armstrong BW. A new treatment for chronic secretory otitis media. AMA Arch. Otolaryngol. 1954 Jun;59:653-654.
(75) Rosenfeld RM. Surgical prevention of otitis media. Vaccine 2000;19:S134-9.
(76) Le CT, **Freeman DW**, **Fireman BH**. Evaluation of ventilating tubes and myringotomy in the treatment of recurrent or persistent otitis media. Pediatr.Infect.Dis.J. 1991;10:2-11.
(77) Rosenfeld RM, **Bhaya MH**, **Bower CM**, **Brookhouser PE**, **Casselbrant ML**, **Chan KH**, et al. Impact of tympanostomy tubes on child quality of life. Arch.Otolaryngol.Head.Neck.Surg. 2000;126:585-592.
(78) Richards M, **Giannoni C**. Quality-of-life outcomes after surgical intervention for otitis media. Arch.Otolaryngol.Head.Neck.Surg. 2002;128:776-782.
(79) Rovers MM, **Krabbe PF**, **Straatman H**, **Ingels K**, **van der Wilt GJ**, **Zielhuis GA**. Randomised controlled trial of the

effect of ventilation tubes (grommets) on quality of life at age 1-2 years. Arch.Dis. Child. 2001;84:45-49.
(80) Paradise JL, Feldman HM, Campbell TF, Dollaghan CA, Rockette HE, Pitcairn DL, et al. Tympanostomy tubes and developmental outcomes at 9 to 11 years of age. N.Engl.J.Med. 2007;356:248-261.
(81) Paradise JL, Campbell TF, Dollaghan CA, Feldman HM, Bernard BS, Colborn DK, et al. Developmental outcomes after early or delayed insertion of tympanostomy tubes. N.Engl.J.Med. 2005;353:576-586.
(82) Valtonen H, Tuomilehto H, Qvarnberg Y, Nuutinen J. A 14-year prospective follow-up study of children treated early in life with tympanostomy tubes: Part 1: Clinical outcomes. Arch.Otolaryngol.Head. Neck.Surg. 2005;131:293-298.
(83) Valtonen H, Tuomilehto H, Qvarnberg Y, Nuutinen J. A 14-year prospective follow-up study of children treated early in life with tympanostomy tubes: Part 2: Hearing outcomes. Arch.Otolaryngol. Head.Neck.Surg. 2005;131:299-303.
(84) Hoffmann KK, Thompson GK, Burke BL, Derkay CS. Anesthetic complications of tympanostomy tube placement in children. Arch.Otolaryngol.Head.Neck. Surg. 2002;128:1040-1043.
(85) Daly KA, Hunter LL, Lindgren BR, Margolis R, Giebink GS. Chronic otitis media with effusion sequelae in children treated with tubes. Arch.Otolaryngol.Head. Neck.Surg. 2003;129:517-522.
(86) Boston M, McCook J, Burke B, Derkay C. Incidence of and risk factors for additional tympanostomy tube insertion in children. Arch.Otolaryngol.Head.Neck. Surg. 2003;129:293-296.
(87) Cayé-Thomasen P, Stangerup SE, Jorgensen G, Drozdziewic D, Bonding P, Tos M. Myringotomy versus ventilation tubes in secretory otitis media: eardrum pathology, hearing, and eustachian tube function 25 years after treatment. Otol. Neurotol. 2008;29:649-657.
(88) Derkay CS, Carron JD, Wiatrak BJ, Choi SS, Jones JE. Postsurgical follow-up of children with tympanostomy tubes: results of the American Academy of Otolaryngology-Head and Neck Surgery Pediatric Otolaryngology Committee National Survey. Otolaryngol.Head.Neck. Surg. 2000;122:313-318.
(89) Ingels K, Rovers MM, van der Wilt GJ, Zielhuis GA. Ventilation tubes in infants increase the risk of otorrhoea and antibiotic usage. B-Ent 2005;1:173-176.
(90) Desai SN, Kellner JD, Drummond D. Population-based, age-specific myringotomy with tympanostomy tube insertion rates in Calgary, Canada. Pediatr.Infect.Dis. J. 2002;21:348-350.
(91) Ministry of Social Affairs and Health. Yhtenäiset kiireettömän hoidon perusteet: Lasten toistovan tai pitkäaikaisen välikorvatulehduksen leikkaustoimenpiteet [Principles for elective treatment: Surgery for pediatric recurrent or prolonged otitis media] (Finnish). 2005; Available at: http://www.stm.fi/Resource.phx/publishing/store/2005/04/pr1112785786302/passthru.pdf.
(92) Rosenfeld RM, Culpepper L, Doyle KJ, Grundfast KM, Hoberman A, Kenna MA, et al. Clinical practice guideline: Otitis media with effusion. Otolaryngol.Head Neck Surg. 2004;130:S95-118.
(93) van Cauwenberge PB, Bellussi L, Maw AR, Paradise JL, Solow B. The adenoid as a key factor in upper airway infections. Int.J.Pediatr.Otorhinolaryngol. 1995;32:S71-80.
(94) Younis RT, Lazar RH. History and current practice of tonsillectomy. Laryngoscope 2002;112:3-5.
(95) Curtin JM. The history of tonsil and adenoid surgery. Otolaryngol.Clin.North Am. 1987;20:415-419.
(96) Mattila PS, Tahkokallio O, Tarkkanen J, Pitkäniemi J, Karvonen M,

Tuomilehto J. Causes of tonsillar disease and frequency of tonsillectomy operations. Arch.Otolaryngol.Head.Neck.Surg. 2001;127:37-44.
(97) Benjamin BN. Guidelines on tonsillectomy and adenoidectomy in children. Australas.Nurses J. 1982;11:16-19.
(98) Benjamin B. Guidelines on tonsillectomy and adenoidectomy. J.Paediatr.Child Health 1992;28:136-140.
(99) Niemelä M, Uhari M, Luotonen M, Luotonen J, Manninen MP, Puhakka H. Changes in day care attendance rates and in the occurrence of adenoidectomies and tympanostomies. Acta Paediatr. 1998;87:1003-1004.
(100) Derkay CS. Pediatric otolaryngology procedures in the United States: 1977-1987. Int.J.Pediatr.Otorhinolaryngol. 1993;25:1-12.
(101) Coyte PC, Croxford R, McIsaac W, Feldman W, Friedberg J. The role of adjuvant adenoidectomy and tonsillectomy in the outcome of the insertion of tympanostomy tubes. N.Engl.J.Med. 2001;344:1188-1195.
(102) Postma DS, Poole MD, Wu SM, Tober R. The impact of day care on ventilation tube insertion. Int.J.Pediatr.Otorhinolaryngol. 1997;41:253-262.
(103) Maw R, Bawden R. Spontaneous resolution of severe chronic glue ear in children and the effect of adenoidectomy, tonsillectomy, and insertion of ventilation tubes (grommets). BMJ 1993;306:756-760.
(104) Gates GA, Avery CA, Prihoda TJ, Cooper JC,Jr. Effectiveness of adenoidectomy and tympanostomy tubes in the treatment of chronic otitis media with effusion. N.Engl.J.Med. 1987;317:1444-1451.
(105) Randall DA, Hoffer ME. Complications of tonsillectomy and adenoidectomy. Otolaryngol.Head.Neck.Surg. 1998;118:61-68.
(106) Mattila PS, Joki-Erkkilä VP, Kilpi T, Jokinen J, Herva E, Puhakka H. Prevention of otitis media by adenoidectomy in children younger than 2 years. Arch.Otolaryngol.Head.Neck.Surg. 2003;129:163-168.
(107) Hammaren-Malmi S, Saxen H, Tarkkanen J, Mattila PS. Adenoidectomy does not significantly reduce the incidence of otitis media in conjunction with the insertion of tympanostomy tubes in children who are younger than 4 years: a randomized trial. Pediatrics 2005;116:185-189.
(108) Paradise JL, Bluestone CD, Colborn DK, Bernard BS, Smith CG, Rockette HE, et al. Adenoidectomy and adenotonsillectomy for recurrent acute otitis media: parallel randomized clinical trials in children not previously treated with tympanostomy tubes. JAMA 1999;282:945-953.
(109) Kadhim AL, Spilsbury K, Semmens JB, Coates HL, Lannigan FJ. Adenoidectomy for middle ear effusion: a study of 50,000 children over 24 years. Laryngoscope 2007;117:427-433.
(110) Grob GN. The rise and decline of tonsillectomy in twentieth-century America. J.Hist.Med.Allied Sci. 2007;62:383-421.
(111) Donaldson LJ, Hayes JH, Barton AG, Howel D, Hawthorne M. Impact of clinical practice guidelines on clinicians' behaviour: tonsillectomy in children. J.Otolaryngol. 1999;28:24-30.
(112) Vestergaard H, Wohlfahrt J, Westergaard T, Pipper C, Rasmussen N, Melbye M. Incidence of tonsillectomy in Denmark, 1980 to 2001. Pediatr.Infect.Dis. J. 2007;26:1117-1121.
(113) Freeman JL, Jekel JF, Freeman DH,Jr. Changes in age and sex specific tonsillectomy rates: United States, 1970-1977. Am.J.Public Health 1982;72:488-491.
(114) Moloney JR, John DG, Jagger C. Age, sex, ethnic origin and tonsillectomy. J.Laryngol.Otol. 1988;102:649-651.
(115) Ruiz I, Hernandez Aguado I, Garrido P. Variation in Surgical Rates: A Population Study. Med.Care 1998;36:1315-1323.

(116) Darrow DH, Siemens C. Indications for tonsillectomy and adenoidectomy. Laryngoscope 2002;112:6-10.
(117) Alho OP, Koivunen P, Penna T, Teppo H, Koskela M, Luotonen J. Tonsillectomy versus watchful waiting in recurrent streptococcal pharyngitis in adults: randomised controlled trial. BMJ 2007;334:939.
(118) Renko M, Salo E, Putto-Laurila A, Saxén H, Mattila PS, Luotonen J, et al. A randomized, controlled trial of tonsillectomy in periodic fever, aphthous stomatitis, pharyngitis, and adenitis syndrome. J.Pediatr. 2007 Sep;151:289-292.
(119) Blair RL, McKerrow WS, Carter NW, Fenton A. The Scottish tonsillectomy audit. The Audit Sub-Committee of the Scottish Otolaryngological Society. J.Laryngol.Otol.Suppl. 1996;20:1-25.
(120) van den Akker EH, Sanders EA, van Staaij BK, Rijkers GT, Rovers MM, Hoes AW, et al. Long-term effects of pediatric adenotonsillectomy on serum immunoglobulin levels: results of a randomized controlled trial. Ann.Allergy Asthma Immunol. 2006;97:251-256.
(121) van Hattum ES, Balemans WA, Rovers MM, Zielhuis GA, Schilder AG, van der Ent CK. Adenoidectomy and/or tonsillectomy in childhood is not associated with atopic disease later in life. Clin.Exp. Allergy 2006;36:40-43.
(122) Little P. Recurrent pharyngo-tonsillitis. BMJ 2007;334:909.
(123) Burton M. Tonsillectomy. Arch.Dis. Child. 2003;88:95-96.
(124) Burton MJ. Commentary: Tonsillectomy-then and now. International journal of epidemiology 2008;37:23.
(125) Crayford TJ. Time to stop doing tonsillectomies? BMJ 2007;334:1019.
(126) Le TM, Rovers MM, van Staaij BK, van den Akker EH, Hoes AW, Schilder AG. Alterations of the oropharyngeal microbial flora after adenotonsillectomy in children: a randomized controlled trial. Arch.Otolaryngol.Head.Neck.Surg. 2007;133:969-972.
(127) Oomen KP, Rovers MM, van den Akker EH, van Staaij BK, Hoes AW, Schilder AG. Effect of adenotonsillectomy on middle ear status in children. Laryngoscope 2005;115:731-734.
(128) Buskens E, van Staaij B, van den Akker J, Hoes AW, Schilder AG. Adenotonsillectomy or watchful waiting in patients with mild to moderate symptoms of throat infections or adenotonsillar hypertrophy: a randomized comparison of costs and effects. Arch.Otolaryngol.Head.Neck. Surg. 2007;133:1083-1088.
(129) Kendrick D, Gibbin K. An audit of the complications of paediatric tonsillectomy, adenoidectomy and adenotonsillectomy. Clin.Otolaryngol.Allied Sci. 1993;18:115-117.
(130) Krishna P, Lee D. Post-tonsillectomy bleeding: a meta-analysis. Laryngoscope 2001;111:1358-1361.
(131) Blomgren K, Qvarnberg YH, Valtonen HJ. A prospective study on pros and cons of electrodissection tonsillectomy. Laryngoscope 2001;111:478-482.
(132) Nuara MJ, Park AH, Alder SC, Smith ME, Kelly S, Muntz H. Perioral burns after adenotonsillectomy: a potentially serious complication. Arch.Otolaryngol. Head.Neck.Surg. 2008;134:10-15.
(133) Ministry of Social Affairs and Health. Yhtenäiset kiireettömän hoidon perusteet: Toistuvan tai pitkäaikaisen risasairauden kiireetön leikkaushoito [Principles for elective treatment: Recurrent or prolonged pharyngitis] (Finnish). 2005; Available at: http://www.stm.fi/Resource.phx/publishing/store/2005/04/pr1112785786302/passthru.pdf.
(134) Black N. Surgery for glue ear: the English epidemic wanes. J.Epidemiol.Community Health 1995;49:234-237.
(135) Bisset F. Glue ear surgery in Scottish

children 1990-1994: still plenty of ENT and public health challenges. Clin.Otolaryngol.Allied Sci. 1997;22:233-238.
(136) Mason J, Freemantle N, Browning G. Impact of effective health care bulletin on treatment of persistent glue ear in children: time series analysis. BMJ 2001;323:1096-1097.
(137) Pearson RJ, Smedby B, Berfenstam R, Logan RF, Burgess AM,Jr, Peterson OL. Hospital caseloads in Liverpool, New England, and Uppsala. An international comparison. Lancet 1968;2:559-566.
(138) Bloor MJ, Venters GA, Samphier ML. Geographical variation in the incidence of operations on the tonsils and adenoids. An epidemiological and sociological investigation. (Part 1). J.Laryngol.Otol. 1978;92:791-801.
(139) Bloor MJ, Venters GA, Samphier ML. Geographical variation in the incidence of operations on the tonsils and adenoids. An epidemiological and sociological investigation (Part 2). J.Laryngol.Otol. 1978;92:883-895.
(140) Vayda E, Anderson GD. Comparison of provincial surgical rates in 1968. Can. J.Surg. 1975;18:18-19.
(141) Roos NP, Roos LL,Jr, Henteleff PD. Elective surgical rates--do high rates mean lower standards? Tonsillectomy and adenoidectomy in Manitoba. N.Engl.J.Med. 1977;297:360-365.
(142) Vayda E, Barnsley JM, Mindell WR, Cardillo B. Five-year study of surgical rates in Ontario's counties. Can.Med.Assoc.J. 1984;131:111-115.
(143) Newton JN, Seagroatt V, Goldacre M. Geographical variation in hospital admission rates: an analysis of workload in the Oxford region, England. J.Epidemiol. Community Health 1994;48:590-595.
(144) Wennberg JE. Dealing with medical practice variations: a proposal for action. Health.Aff.(Millwood) 1984;3:6-32.
(145) Owings MF, Kozak LJ. Ambulatory and inpatient procedures in the United States, 1996. Vital Health.Stat.1998:1-119.
(146) Close GR, Rushworth RL, Rob MI, Rubin GL. Variation in selected childhood surgical procedures: the case of tonsillectomy and management of middle ear disease. J.Paediatr.Child Health 1993;29:429-433.
(147) Andersen E, Isager H, Hyllested K. Risk factors in multiple sclerosis: tuberculin reactivity, age at measles infection, tonsillectomy and appendectomy. Acta Neurol. Scand. 1981;63:131-135.
(148) Rosenfeld RM, Green RP. Tonsillectomy and adenoidectomy: changing trends. Ann.Otol.Rhinol.Laryngol. 1990;99:187-191.
(149) Wennberg JE, Blowers L, Parker R, Gittelsohn AM. Changes in tonsillectomy rates associated with feedback and review. Pediatrics 1977;59:821-826.
(150) Friedman EH, Regan CM, St Leger AS. Analysis of secular trends in surgery for glue ear in the North Western Region (1975-1984). Community Med. 1989;11:41-48.
(151) Perrin JM, Homer CJ, Berwick DM, Woolf AD, Freeman JL, Wennberg JE. Variations in rates of hospitalization of children in three urban communities. N.Engl. J.Med. 1989;320:1183-1187.
(152) European Observatory on Health Systems and Politics. Health care in transition; Norway. Available at: http://www.euro.who.int/Document/E88821.pdf.
(153) European Observatory on Health Systems and Politics. Health Care in Transition; Finland. Available at: http://www.euro.who.int/document/e74071.pdf.
(154) Academic ENT in Europe, The challenge ahead. ENT News 2005;13.
(155) Rovers MM, de Kok IM, Schilder AG. Risk factors for otitis media: an international perspective. Int.J.Pediatr. Otorhinolaryngol. 2006;70:1251-1256.
(156) OECD country note: Early Childhood Education and Care Policy in

Finland. Available at: http://www.oecd.org/dataoecd/48/55/2476019.pdf.
(157) OECD Country Note;Early Childhood Education and Care Policy in Norway. Available at: http://www.oecd.org/dataoecd/52/29/2534885.pdf.
(158) Statistics Finland. EU-maiden elinolot vertailussa: äitien työssäkäynti yleistä Suomessa [Comparing EU countries:mothers working outside the home common in Finland] (Finnish). Available at: http://www.stat.fi/ajk/tiedotteet/v2005/tiedote_058_2005-10-25.html.
(159) Statistics Norway. Available at: http://www.ssb.no.
(160) Seiskari T, Kondrashova A, Viskari H, Kaila M, Haapala AM, Aittoniemi J, et al. Allergic sensitization and microbial load--a comparison between Finland and Russian Karelia. Clin.Exp.Immunol. 2007;148:47-52.
(161) Bakken HN, Nafstad P, Bolle R, Nystad W. Skin sensitization in school children in Northern and Southern Norway. J.Asthma 2007;44:23-27.
(162) Hammarén-Malmi S, Saxén H, Tarkkanen J, Mattila PS. Passive smoking after tympanostomy and risk of recurrent acute otitis media. Int.J.Pediatr.Otorhinolaryngol. 2007;71:1305-1310.
(163) Lund KE, Skrondal A, Vertio H, Helgason AR. Children's residential exposure to environmental tobacco smoke varies greatly between the Nordic countries. Scand.J.Soc.Med. 1998;26:115-120.
(164) Lund K, Helgason A, Andersen M. Endringer i småbarnsforeldres rapportering om passiv røyking [Changes in small children's parents reporting on passive smoking] (Norwegian). Tidsskr. Nor. Lægeforen. 2004;124.
(165) Mikkola H, Keskimäki I, Häkkinen U. DRG-related prices applied in a public health care system--can Finland learn from Norway and Sweden?. Health Policy 2002;59:37-51.
(166) Pekurinen M. Hoitotakuun taloudellisten vaikutusten ennakointia [Predicting the economical effects of the treatment guarantee] (Finnish). SLL 2005;60:1303-1307.
(167) STAKES. Available at: http://www.stakes.fi.
(168) Norwegian Patient Registry. Available at: http://www.npr.no.
(169) Statistics Finland. 2006; Available at: http://www.stat.fi.
(170) The Finnish Medical Association. Available at: http://www.laakariliitto.fi.
(171) The Norwegian Medical Association. Available at: http://www.legeforeningen.no.
(172) World Health Organization. ICD-10. Available at: http://www.who.int/classification/icd/en.
(173) NOMESCO. Available at: http://www.nom-nos.dk/NOMESCO.HTM.
(174) Bassand JP. Improving the quality and dissemination of guidelines: the quest for the Holy Grail. Eur.Heart J. 2000;21:1289-1290.
(175) Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud PA, et al. Why don't physicians follow clinical practice guidelines? A framework for improvement. JAMA 1999;282:1458-1465.
(176) Grol R, Zwaard A, Mokkink H, Dalhuijsen J, Casparie A. Dissemination of guidelines: which sources do physicians use in order to be informed? Int.J.Qual.Health Care 1998;10:135-140.
(177) **Greco PJ, Eisenberg JM**. Changing physicians' practices. N.Engl.J.Med. 1993;329:1271-1273.
(178) Honkanen PO, Rautakorpi UM, Huovinen P, Klaukka T, Palva E, Roine R, et al. Diagnostic tools in respiratory tract infections: use and comparison with Finnish guidelines. Scand.J.Infect.Dis. 2002;34:827-830.
(179) Blomgren K, Pohjavuori S, Poussa T, Hatakka K, Korpela R, Pitkäranta A. Effect of accurate diagnostic criteria on in-

cidence of acute otitis media in otitis-prone children. Scand.J.Infect.Dis. 2004;36:6-9.
(180) Uhari M, Niemelä M, Hietala J. Prediction of acute otitis media with symptoms and signs. Acta Paediatr. 1995;84:90-92.
(181) Blomgren K, Pitkäranta A. Is it possible to diagnose acute otitis media accurately in primary health care? Fam.Pract. 2003;20:524-527.
(182) Kujala J, Rihkanen H. Lääkärilakon vaikutus lasten toistuvien korvatulehdusten kirurgiseen hoitoon [The effect of the strike of Finnish physicians on the surgical treatment of paediatric recurrent otitis media] (Finnish). SLL 2004;59:187-191.
(183) Horwitz SM, Horwitz RI, Morgenstern H. Maternal employment, maternal care and pediatric visits for minor acute illnesses. J.Clin.Epidemiol. 1993;46:981-986.
(184) Saunders NR, Tennis O, Jacobson S, Gans M, Dick PT. Parents' responses to symptoms of respiratory tract infection in their children. CMAJ 2003;168:25-30.
(185) Carabin H, Gyorkos TW, Soto JC, Joseph L, Payment P, Collet JP. Effectiveness of a training program in reducing infections in toddlers attending day care centers. Epidemiology 1999;10:219-227.
(186) Alho OP, Läärä E, Oja H. Public health impact of various risk factors for acute otitis media in Northern Finland. Am.J.Epidemiol. 1996;143:1149-1156.
(187) Kim MR, Lee HR, Lee GM. Epidemiology of acute viral respiratory tract infections in Korean children. J.Infect. 2000;41:152-158.
(188) Jensen-Fangel S, Mohey R, Johnsen SP, Andersen PL, Sorensen HT, Ostergaard L. Gender differences in hospitalization rates for respiratory tract infections in Danish youth. Scand.J.Infect.Dis. 2004;36:31-36.
(189) Aro S, Koskinen R, Keskimäki I. Sairaalastapoistorekisterin diagnoosi-, toimenpide- ja tapaturmatietojen luotettavuus [Reliability of hospital discharge data concerning diagnosis, treatments and accidents] (Finnish). Duodecim 1990;106:1443-1450.
(190) Keskimäki I, Aro S. Accuracy of data on diagnoses, procedures and accidents in the Finnish Hospital Discharge Register. Int. J. Health Sciences 1991;2:15-21.
(191) Bakken IJ, Skjeldestad FE. Insidens og behandling av ekstrauterine svangerskap i Norge 1990-2001 [Incidence and treatment of extrauterine pregnancies in Norway 1990-2001] (Norwegian). Tidsskr.Nor. Laegeforen. 2003;123:3016-3020.
(192) Lofthus CM, Cappelen I, Osnes EK, Falch JA, Kristiansen IS, Medhus AW, et al. Local and national electronic databases in Norway demonstrate a varying degree of validity. J.Clin.Epidemiol. 2005;58:280-285.
(193) Keskimäki I, Salinto M, Aro S. Private medicine and socioeconomic differences in the rates of common surgical procedures in Finland. Health Policy 1996;36:245-259.